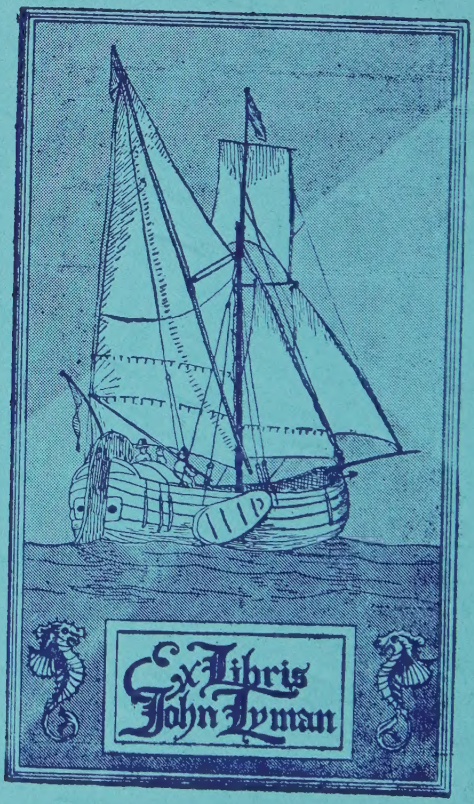
ALSTON'S

SEAMANSHIP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CAPTAIN ALSTON'S

SEAMANSHIP.

FOURTH EDITION.

REVISED AND ENLARGED

BY

CAPTAIN T. P. WALKER, R.N.

INCLUDING

FITTING OUT; GETTING IN MASTS; WIRE ROPE; BREAKING STRAINS;
BERTHING AND MESSING SHIP'S COMPANY;
RULE OF THE ROAD; MAKING AND SHORTENING SAIL;
LAWS OF STORMS; SAILING TRIALS; SHIFTING SAILS AND SPARS;
SIGNALS; FLAGS; ORGANIZING A FLEET; ANCHOR WORK;
HOISTING IN GUNS, &C.; ACTION OF RUDDER; COALING SHIP;
JURY RUDDERS; TOWING SHIPS;
SALVAGE WORK; RECENT SUCCESSFUL SALVAGE OPERATIONS;

WITH

INSTRUCTIONS

FOR

OFFICERS OF THE MERCHANT SERVICE,

CAREFULLY REVISED AND BROUGHT DOWN TO DATE, WITH COPIOUS ILLUSTRATIONS AND COLOURED FLAGS.

1902.

PORTSMOUTH:
GRIFFIN & CO., 2, THE HARD,
(PUBLISHERS BY APPOINTMENT TO HER LATE MAJESTY QUEEN VICTORIA).
LONDON AGENTS:—SIMPKIN, MARSHALL & CO.

PRINTED AT THE OFFICE OF THE PUBLISHERS, THE HARD, PORTSMOUTH.

TO

THE JUNIOR OFFICERS OF THE NAVY,

This Work,

WRITTEN FOR THEIR GUIDANCE,

IS INSCRIBED BY

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EXPLANATIONS.

SECTION I.

Chapter I.

FITTING OUT.

1. Rigging Sheers—The sheers having been towed alongside, with their heads aft, take two stout hawsers, middle them, pass the bights over the ends of the spar, and secure the underneath ends inboard, the hammock berthing having been previously removed. Reeve the hauling parts of the hawsers through leading blocks on the opposite side of the deck. Hang small spars from the chains, to keep the sheers clear, in coming in. Man the hawsers,—tackles having been clapped on if necessary; parbuckle the spar up to the upper works, and take a turn with the hawsers. Secure three or four small spars in a slanting direction, inboard from the upper works to ease the sheers down on, and pass the bight of a small hawser from the main-deck ports over each end of the spar for the same purpose, making one end fast and making a turn with the other; then haul away on the parbuckle, and ease away on the main-deck hawsers till the spar is landed. Proceed with the other in the same manner.

However, instead of parbuckle, I should, in preference, get sheers in over the stern, by rigging small sheers over the taffrail, and by them lifting the end of the spar up to the stern port on the upper deck; then clap on a tackle led along the deck, and rouse it in. By clearing away the head berthing, they may also be advantageously got in forward; in which case, the lighter end of the sheers would come first.

When in, rig a small pair of sheers; with them raise the sheer-heads on the poop, cross them by placing the sheer-head of the side on which the mast is coming in uppermost and lash them with a round lashing of 4in., passed on the bight six or seven turns *on each end*, then back again with riding turns, making 23 or 27 turns in all, and knot.

Protect the sheer-head lashing carefully with old canvas where the purchase-strop takes, and take a four fold block, double stropped, for the upper block of the main purchase; place the bight of the starboard end over the starboard sheer-head, and the bight of the port end over the port sheer-head then reeve the ends contrary ways through the bights of the strop, pass bight and bight as before, and knot the ends when the lashing is expended.

The upper block of the small purchase (an upper jeer-block), is placed on the underneath or after part of the sheers, lashed as the other, but hanging below it, the bights lying on the fore side, and across the turns of the main purchase strop.

Then lash the topping-lift, for which the fish-tackle will do.

For sheer-head guys, which are placed next, take the three 9-in. and a $7\frac{1}{2}$-in. hawser, which reeve through four top-blocks lashed at the sheer-heads, those for the fore-guys being uppermost.

For the belly-guys, on the fore and after side of each sheer leg, use the fore and main runners and tackles, and reeve sheer-head gantlines.

Reeve the purchase, using a three-fold purchase block, and another upper jeer-block for the lower blocks, overhaul the fore-guys and main purchase forward, the former to the cat-heads, and the latter toggled through the hole for the bowsprit. Open the sheers out, place the shoe, lash the heels securely, but slackly, to a fish davit, or other spar, laid outside the nearest port abaft the heels, and shore all decks well up underneath. Hook up-and-downs forward and aft on each side, as heel-tackles. Bring the purchase to the capstan, man well the fore-guys, and attend the after-guys and heel-tackles. Raise the heads by the small sheers, heaving round and hauling on the purchase ; unrig the small sheers when they are of no further use, and heave away. When on end, hook a couple of luffs from one heel to the other, which bowse well taut and frap ; transport the sheers aft to the break of the poop,—wetting the deck, and keeping the heels in advance, lash the heels taut between the ports, over cleats on the sheer-legs, looking out that they are stepped over a beam, bowse taut the heel-tackles, set all the guys well up (the sheer-head guys with luffs), and come up the purchase forward.

2. RIGGING SHEERS FOR MASTINC SHIP IN A CORVETTE WITH OWN RESOURCES.—Use the fore and main yards with fishes lashed to the yard-arms. For the main purchase use the two largest treble blocks in the ship, which would probably be the screw purchase blocks, and a 6 inch hawser

for the fall. For the small purchase use the two treble cat purchase blocks and the cat fall. For the topping lift use the fish tackle. In all other respects proceed as in Art. 1.

Two topmasts might be used as sheers instead of the lower yards.

A good lashing or tackle must be put on to the leg of the off sheer to prevent it lifting off the deck, as there is a great tendency for this to happen before the mast gets over the ship's side.

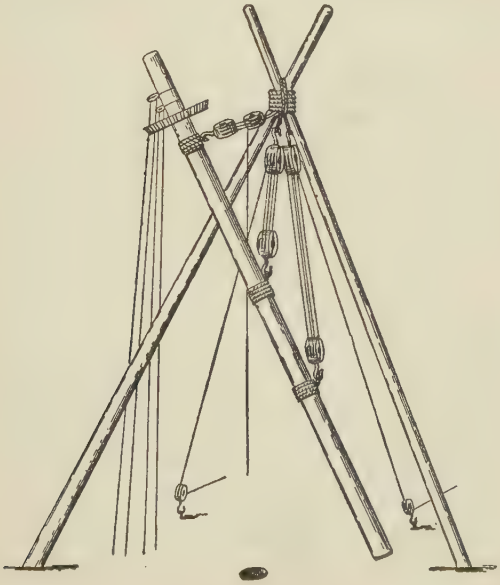
The hawsers used as guys may, if preferred, be middled and clove-hitched round the sheer-heads.

When sheers are very disproportionate to the length of the masts you are getting out, the purchase would be two blocks when the heel but just clears the upper-deck partners, as you would not be able to take it higher on account of the great top weight: it consequently would be too low to clear the upper works unless lowered in an athwartships direction, and then roused over bodily before lowering the heel. This, however, would be a work of great danger and difficulty, as the heel-tackles would be eased up, and the whole leverage of the top weight thrown on the upper purchase. Under such circumstances, the mast should be sent over on the opposite side, head downwards; easing up the head-tackles and lowering the purchase.

3. Getting in Lower-masts and Bowsprit.—The masts should have the gantline blocks and strops for the purchases to toggle to, lashed before launching. The height of the sheers, the length of the mast, and the depth of the housing must regulate the position of the strops; but supposing the sheers are as taunt as you desire, lash the strop for the main purchase just above the upper-deck partners, the strop for

the small purchase above the centre of the mast, and the topping-lift at the mast-head. Canvas must be placed round the mast under the lashings, and cleats nailed above to prevent them slipping.

The mizen-mast being alongside, with the head aft, overhaul the small purchase down, and hook the topping-lift to a strop below the trestle trees. Lead the fall down the after hatchway, through a leading block, and bring it to the capstan. Sway away, and when up to the main-deck ports, pass a couple of hawsers out, which bend to the head and heel, ready to ease away as you sway inboard. Reeve the mast-head gantlines, clap a tackle on the heel to bowse it over the mast-hole, pull up on the topping-lift and point the



mast, walk back, heave it on the right slue, and lower it into the step; drive four or five wedges in, and come up the purchase.

Transport the sheers before the main partners, and get the mainmast in, in the same manner. Lead the main purchase down the main hatchway, through the leading-block, and bring it to the main capstan; and the small purchase, with the same lead, bring to the fore capstan. The topping-lift work on deck.

Having similarly got the foremast in, keep fast the belly-guys to steady the sheers, unreeve the fore sheer-head guys, and shift the blocks to the hounds of the foremast. Come up the after sheer-head guys, and secure one part of each to the foremast-head close down, and reeve the other ends through the blocks, and so down on deck, thus converting them into sheer-head topping lifts.

Haul down on the purchase, ease away topping-lifts and droop the sheers; then the belly-guys being of no further use, take them off, and shift the fore runners and tackles to the after part of the foremast-head, lashing the blocks where the standing parts of the topping lifts are secured; then take them aft, and set them up for the support of the mast.

In the same manner as for the mizen-mast, the small purchase and topping-lift, the latter slued round, will bring the bowsprit in which should be slung midway between the housing and the centre. Send the purchase down abaft the boomkin, for, if before, you would jamb the bowsprit between it and the cutwater, and be thereby prevented from swaying it higher; toggle on, hook the topping-lift to a strop through the cap, where also hitch a couple of guys rove through

blocks at the cat-heads. Sway away, topping on the cap purchase when necessary; when clear of the boomkin, drop the sheers to the required angle, and sway away; point the heel, ease up the main purchase, and, if the partners are well greased, the mast will come down into its place as you pull up on the cap purchase, without the aid of bedding-tackles.

The heels of the sheers are then fleeted aft, the sheers lowered down by the topping-lifts, unrigged and hoisted out.

4.—GETTING WHOLE TOPS OVER.—Up-end the top on its after-edge abaft the mast, underneath side of the top, forward. Lash the gantline blocks on each side of the mast-head, as close up as possible, frapping them over the head of the mast to keep them well up. Take the after end of each gantline under the top, up through the after (or next to after) futtock hole, down through the lubber's hole; and after this, reeving up through the foremost futtock hole; hitch the end of each gantline to its own part at lubber's hole. Then get a guy from aft, bend it to the after part of the top and stop with two gantlines already bent to the holes in the fore part of the top. Steady taut the after guy, sway away the gantlines, keep the top clear of the trestle trees with the after guy; when close up cut the stops, sway the top over, ease it down, place it, cast off the gantlines, get up the sleepers, and bolt the top down to the crosstrees. A mizen-top is nearly always sent up before the mast, that you may have the assistance of a gantline from the mainmast; if this is done, place the top before the mast, as it would lie when over; bend the mizen gantlines to the foremost futtock

holes, and the main gantline to the fore part of the top ; stop all three gantlines to the after part of the top, and sway as before.

5. GET HALF-TOPS OVER.—Place the half-tops on the deck each side of the mast, as if in their place ; lash two planks across the trestle trees, with a bolt lashed on the top of each, exactly between the trestle trees. Take the after end of the gantlines abaft all, each on its own side ; bend to the half-tops with a round-turn as near the centre as possible, and hitch each to its own part ; stop the bight to the futtock hole abreast the hitch ; bend a gantline from abaft to the after part of the half-top, to keep it clear as it goes up ; sway until above the crosstrees, rest the midship parts on the planks against the bolts, lower the gantline, remove the planks, place the sleepers and bolt down.

6. SENDING TOPS DOWN.—Bend each gantline with a round turn through the lubber's hole and one of the futtock holes, so slinging the top that the after part will be slightly heavier ; bend a gantline or guy to the fore-part of the top, from abaft, to bring the top aft when swayed off ; unbolt and send down the sleepers, bend a rope's end from the deck to the fore-part of the top, to keep it square while swaying. When this has been done, sway till the fore-part clears the mast-head, haul on the after gantlines, guy clear of the trestle trees ; unbend the rope's end and lower away.

Half-Tops.—Commencing with port half.—Bend the port gantline round the half-top at fore-part of lubber's hole and stop it to the fore-part of the top. Bend a fore and aft gantline to the after part of the top, sway the upper gantline,

haul on the fore and aft gantline, and when clear of the trestle trees, lower away, and proceed in the same manner with the other half.

7. GANTLINES.—For the fore and mainmast, the top tackle-falls are drawn; peak and throat halyards for the mizen-mast.

8. GANTLINE UNROVE.—Direct the man at the mast-head to draw the splice of the block-strop, unlay the strands and knot the yarns, then send them down as a hauling-line.*

9. CUTTING OUT RIGGING.—Hemp rigging is now almost unknown in Her Majesty's Service; but as the question of how it was fitted, may still be asked, I have thought it as well to insert the answer. Measure the distance with spun-yarn, from the bolster on one side of the mast, to the foremost dead-eye in the chains on the other; or take the length of the mast from the wedges to the bolsters, as one side of a right-angled triangle, and the distance from the centre of the mast-hole to the crown of the foremost lower dead-eye as the other, find the third side.

At this distance place two posts: take the shroud hawser and lay its end at either post, warp round and round both, laying each turn carefully outside the other, one complete turn for each pair of shrouds, and half-a-turn for the pendants.

* This is a standard *catch question*, and is inserted as a specimen of nautical enigma known as such. Many midshipmen labour under the delusion that elaborate improbabilities of this description form the staple of the final examination for lieutenant. I have heard a captain under whom I served some years ago, gravely accused of turning a midshipman back for not knowing how to *stow a hold in a gale of wind.* And there is a tradition afloat of an unfortunate candidate having *missed stays*, in consequence of being puzzled how to get a bower anchor out, which was lying inboard; there being no masts or spars in the ship wherewith to raise it. Considerable erudition has been displayed in discussing this question; and I believe that in such a dilemma the correct thing is to hoist it out with a derrick, formed of its own stock!

Take once-and-a-quarter round the mast above the bolsters, and half this distance, measured from the crown of the shrouds, will be the point for commencing the first turn of each serving, which mark with chalk, cut through the centre of the bights at the end you commenced warping; and on the crown of the other bights, marked with knotted spunyarn, the number of the shroud, commencing with one knot on the inside bight for the purpose of distinguishing them. Run a chalk mark across the upper bights, distant from the post a third of the distance from the deck to the bolsters, which, when you fit the rigging will mark the termination of the service.

Get each length on the stretch separately, ready for fitting. New rope before fitting should be stretched one inch to the foot.

Worm, parcel, and serve the eyes of each pair of shrouds to the chalk mark, but continue the foremost shroud on each side, the whole way down. Parcel the shrouds in the wake of the serving, to keep it from sinking between the parts of the service.

Wire rigging should not be warped off, but the length of the foremost and after shrouds should be measured from the foremost and after dead-eyes in the chains to the bolster on the opposite side; divide the difference in length between the intermediate shrouds, adding the diameter of the rope to each pair in succession.

A wire shroud is completely served over; the pendants are fitted with an eye of the same size, and in the same manner as the shrouds; one leg being one-third longer than the other, with thimbles spliced into each end.

If it is necessary to have an odd number of shrouds, it will be found a good plan instead of connecting them with a horse-shoe splice, to fit an eye splice in each and put them on first.

Measure the drift for the stays, and form a collar the length of the masthead, by splicing a fork into the upper end. Form a Flemish eye at each end of the fork, and worm, parcel, and serve, a fathom below the crutch.

Wire stays are not served completely over, in fact wire rigging now, with the exception of the shrouds, is only served over in places where it may be subjected to chafe, or exposed to the action of water as in the case of bobstays.

In parcelling rigging, the canvas should always be worked up, to prevent water getting between the parts of the parcelling.

This is an exception to the old sea rhyme which runs :—

"Worm and parcel with the lay,
Then serve and marl the other way."

10. Rig the Foremast.—Get up, lash, and steady taut the runners and tackles, the uppermost just under the neck-lace, and the lowermost two-thirds up from the deck. Shift the two mast-head gantlines down to the after crosstrees on each side of the mast, and lash a block on the after side of the mast-head for a short gantline, to reach into, and be worked in the top.

A shroud is sent over, by seizing both parts of a pair together about a quarter down, the gantline bent to a toggle and slipped under the seizing, a rope's end being also bent to it to round down again. The gantline is stopped to the shroud below the eye-seizing, and at the crown of the eye,

which is kept open with a piece of spunyarn from the crown to the seizing. Sway away, and when it comes up to the top, bend on the short gantline under the seizing, stop it up to the crown, on the upper side of the shroud, cut the stops of the long gantline, and sway over the mast-head. A short gantline is used, to avoid the trouble of hauling up and dipping the long gantline as you sway each pair of shrouds over, which would be the case were they kept at the mast-head.

Then, first tarring and parcelling the bolster, place the rigging as follows :—starboard and port pendants, starboard and port pair of shrouds, and so on ; beat each shroud well down with commanders ; then the after shroud on each side, fitted with an eye splice or horse-shoe. After each pair of pendants and shrouds are roused down separately into their places with up-and-downs on each side, and a luff on each shroud of a pair (both brought to the up-and-downs), the fore stays are sent up by the gantlines, and lashed with a rose lashing abaft the mast.* Then lying close down on the stays, having been passed up between the collars, the jeer block strop is lashed abaft the mast. Over all, close down to the trestle-trees, is the strop for the fore stay tackle or tackles, fitted with one or two thimbles, as the case may be, and hanging down abaft the mast-head. If a chain strop is used instead it should be placed on the bolsters before the rigging. After the pendants, a strop with a large thimble seized into the after part is usually placed for the spring main topmast stay to set up to,—the strop itself set up with two lashing-eyes

* The collars of lower stays are sometimes taken over the cross-trees and cleated down on the mast-head, to allow the yards to brace up the sharper.

before the mast; but this is inconvenient for setting up. A better plan is, to bring the stay down on deck after reeving it through the block abaft the mast, and there set it up.

The rigging is next set up temporarily, being turned in with spunyarn, and both shrouds of a pair pulled up together; previously setting taut the fore stays if the bowsprit is secured.

After the stays and rigging have had a second good pull, each shroud being equally taut, looking out for the mast all the time, mark the rigging off and turn in for a full due.

This is done by seizing a sheer-batten along the rigging parallel to the chains, and about three feet from the top of the lower deadeye, which if it is well stretched, is a good drift for turning in new rigging. Mark the shrouds and take the batten off. Then measure down a couple of feet on each shroud for half the round of the deadeye, which mark off for the crown of the bend for turning in, and, by strictly adhering to this, you will insure your rigging being turned in square, and leave the required drift of about three feet from deadeye to deadeye.

Everything being come up, bring to and steady taut the foremost swifters: then knock out all the wedges, hook a tackle (luff upon luff), from forward to a strop round the mast close down to the deck, and with it and the runners and tackles (steadied forward against a staytackle from the mast head, aft,) bring the mast to its intended rake. Supposing the mast then to be in all particulars well stayed drive the wedges in, keeping fast the tackles till you have done so, taking care not to alter the position of the mast; and the wedges ought never to be started again except to alter the rake. You may then set up the fore stays, making

a small allowance for the mast coming aft as the rigging is pulled up; then set up the after swifters against the stays and the rest of the shrouds in succession, commencing with the foremost pair.

11. Set up Fore Rigging.—The purchase used for setting up lower rigging is an "up-and-down," and a luff. The double block of the up-and-down is lashed or shackled to the lower pendant, and the single block hooked to a cat's paw in the hauling part of the luff; the single block of the luff being to a selvagee strop round the shroud, parcelled in the nip, and the double block brought to the lanyard,—the end of the luff being used to round down.

The fore-stays are set up in the same manner as the shrouds, but the lanyard is middled and set up on both ends; necessitating the use of one luff, and one "up-and down" for each end of the lanyard, the falls must be taken through leading blocks, and kept in a line with the stays.

In refitting, when on a long summer's day the rigging should be turned in afresh, fore and aft, if it requires it, and set up, rattled and blacked down before sunset, the loss of time consequent on waiting for the up-and-downs till the stays are secured is of importance: therefore, make use of the stay tackles, the spans being fitted to unhook, and the pendants taken round the mast-head; so that directly they have got enough of the stays, without waiting for securing, start with the rigging. The ends of stays and rigging are whipped and capped with canvas.

12.—Staying Masts and the Use of Battens.—Conjointly with marks on the deck and masts, battens are used in setting up rigging to show whether the mast requires

to go to starboard or to port, forward or aft. To cut them in the first instance, draw a line from the centre of the mast hole across deck, measure off two equal distances on each side of the mast, and mark the extremities. Take two long battens of equal length, place one end of each on the marks on each side of the deck, and rest the other ends against the mast. Pull the rigging up on either side, till the two ends come abreast of each other, and the mast must, necessarily, be upright. Drive a nail on each side of the mast and deck for permanent marks, but one batten only need now be retained.

The rake being determined, say half-an-inch to the foot, a plumb-line is dropped from the centre of the mast, from any distance up, and the mast raked till a corresponding is plumbed. If, for instance, the plumb-line is dropped from the trestle trees at 60 feet, the line must plumb at 30 inches abaft the mast.

"The rake of the mast has reference to the keel; but as the deck and the keel are not parallel, the angle between their planes must be considered, when determining the angle the batten should have to the deck, in order that it may have the assigned angle to the keel."—*Art. 1301. Queen's Regulations and Admiralty Instructions, 1893.*)

Draw a fore-and-aft line from the centre of the mast, place the end of the batten on it, either before or abaft the mast as most convenient; mark where the ends take the mast and deck with a couple of nails; this, with the side marks and batten, are for future guidance; it being needed

merely to place the batten afterwards against the mast, to show how the latter requires to be moved.*

13. Object of Raking Masts.—As the pressure of the wind is perpendicular to the plane of the sail, raking masts produce lifting sails, though the direct propelling power is somewhat lessened thereby; the loss varying in square sails, as versine of angle of rake.

By the mizen-mast raking considerably, it the more effectually resists the forward strain brought upon it by its own braces and those from the mainmast, and at the same time increases the space between it and the mainmast.

Fincham says, that " the whole of the masts should rake, so that, when the ship is inclined to her most common angle, the plane of the sails should be perpendicular to the longitudinal axis of the ship, or else part of the force of the wind that acts on the sails must depress the ship."

* The regulations, above quoted, state, that, "in consequence of the injudicious manner in which the masts have been stayed, and the lower rigging set up," they are frequently crippled ; and provide that "to regulate the setting up of rigging, and to determine if a lower mast is straight, a middle line should be cut on each of its sides and upon the after part. These lines should be painted a different colour from the rest of the mast, and extend from the trestle tree to the heel. At the upper part of each line a small eyebolt should be placed, and on the line near the deck another such eyebolt. A rope line fastened to the upper one, and rove through the lower, and pulled tight, will, if the mast be straight, coincide with the middle line cut upon it ; or, if not straight, the fact will be evident by the cut line and the rope not being parallel. The amount by which parallelism is departed from, will represent any curve the mast has taken."

14 Determining Rake of Masts.—Presuming that the angle between deck and keel is so small as not to be noticeable in a small distance,—

$$192 : 2 :: 64 : x$$
$$x = 8 \text{ inches.}$$

15. Staying Masts in Dock.—This of course is preparatory to cutting a batten, which could always be used irrespective of the ship's trim. Supposing, then, that you drop the plumb line from 60 ft. up the mast:—

$$200 : 3 :: 60 x \therefore x = 10{\cdot}8 \text{ in.}$$

½ in in a foot = 30 in. 60 feet; so 30 in. - 10·8 in. = 19·2 in., the rake in 60 feet, to be given in the first instance—angle between deck and keel as before.

16. Length of Lower Pendants.—In the first place to stay the mast, the runner-blocks must be lashed some way down, to keep the mast from buckling: this determines the length of one pendant. Another pendant is required to lash the tackle to, for setting up the stays; and, to bring it in a line with them, must be dipped over the lower yard. This must necessarily be the foremost one, but as it is unnecessary to cut it longer than is required to keep the tackle clear of the yard, it is therefore the shorter of the two. One-third of the length of the mast from deck to trestle-trees is sufficient for the long pendant, and one-third less for the short one.

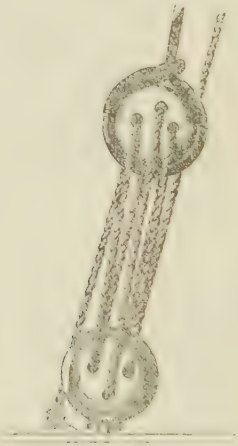
17 Placement of Stays.—The starboard stays are the standing, and the port the spring stays; for the port go on first, and consequently, being the lowermost, are the proper ones for setting a sail on; (if set on the upper stay, the sail

would chafe across the lower one). The starboard fore and fore-topmast stays are therefore the upper and outer ones.

18. Standing Parts of Stay Lanyards.—The standing part of the lanyard of a bobstay is rove with a running eye round the collar above the heart, and acts as a preventer seizing. The lanyard of a lower stay, being worked on both ends, has no standing part, and, when rove full, the ends are seized to the other parts of the lanyard.

19. Comparative small Size of Mizen Stays.—Because the braces on the mizen-mast, by leading forward, assist the stays.

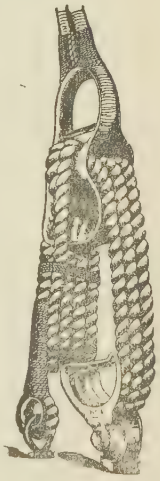
20. Turning in Rigging Cutter's Stay Fashion.—On the starboard side with the nip aft—port side, forward;



ends, on both sides, inboard. The reason of this is that rigging should be turned in as the rope would be coiled down, so that it at once accommodates itself to the bend it would naturally take, and no turns are taken out of the lay of the

rope. With left handed rope the same principle holds good, and the result is necessarily reversed. However, with wire rigging, for the sake of uniformity in appearance, both sides are generally turned in alike, with the nip forward, and the end inside and aft.

21. Turning in with the End up.—With the right-handed rope the end will be, on the starboard side, aft ; and, on the port side, forward, crossing inside ; this was the old plan, but wire rigging is now often turned in end up, without crossing, with the end inside.



22. Lead of the Stays.—

Fore stays, from foremast-head to bowsprit, or knightheads.

—topmast stays, from topmast-head through a check at the bowsprit cap, then in along bowsprit.

—top-gallant stay, from top-gallant mast-head to jibboom end, and dolphin-striker.

—royal stay, from royal masthead, to flying-boom end and dolphin-striker.

Main stays, from mainmast-head, to bolts in the deck on each side of the foremast.

—topmast stay, standing, from topmast-head through iron-bound clump blocks shackled to hoops on the foremast head, and set up abaft the foremast with lanyards to bolts in the deck.

Main top-gallant stay, from top-gallant mast-head, through a roller sheave in fore cap, and sets up in top.

—royal stay, from royal mast-head, through sheeve-hole in fore topmast cross-trees admidships, and sets up in top.

Mizen stays, from mast-head, over rollers ten or twelve feet up mainmast, and set up to bolts in partners.

—topmast stay, from topmast-head, to strop between eyes of main rigging.

—top-gallant stay. from top-gallant mast-head, through a roller sheeve in main cap, and sets up in top.

—royal stay, from royal mast-head, through sheeve-hole in main topmast cross-trees amidships, and sets up in top.

23. Strongest Plan of Turning in Rigging.—By experiments on the three different plans it was found that, under a pressure of a breaking strain, a shroud first gives way at the splice. The next weak point was found, in the cutter's-stay plan, at the nip. The old plan broke at the main part of the rope, at the maximum strain, which when the seizings are carefully put on, is therefore the strongest; but, by the working of the ship the seizings are liable to slip, and more strain is brought on one part than another, which is the reason that the cutter's-stay plan has been so generally adopted.*

24. Throat Seizing.—The end of a throat-seizing is not cut off after the knot is formed, but two or three feet are left and expended round the shroud below the seizing; for, if cut off, there would be no end to work with on turning the rigging in afresh. The knot of the seizing is underneath.

*Tinmouth.

25. Lanyards of Lower Rigging.—Are spliced round a thimble in an eye-bolt in the chains, inside the dead-eye; before the dead-eye on the starboard side, and abaft on the port side; then through the foremost hole in the dead-eye (starboard side), from in—out, and when rove full, the hauling part will be found under the standing part of the shroud; for there it is that the first and greatest strain comes when setting up, which, if the lanyard were rove any other way, would be brought on the seizing, and would moreover cause the dead-eye to slew. By bringing the standing part to the chains, the purchase is increased; and the tendency to capsize, which dead-eyes in new rigging are liable to, is counteracted. With modern iron dead-eyes the lanyards are rove in a similar manner. Lanyards are half the size of the shroud, supposing the latter to be hemp. If wire shrouds, lanyards are usually $\frac{1}{3}$in. larger than the shrouds.

In modern Battleships there are no lanyards, but the shroud is turned in round a heart thimble and then secured by means of a screw and slip.

26. To Bring To.—A couple of turns of the lanyard are taken round a large toggle; a strop is then middled, and a turn taken with it round both parts of the lanyard under the toggle, and the luff hooked to the bights.

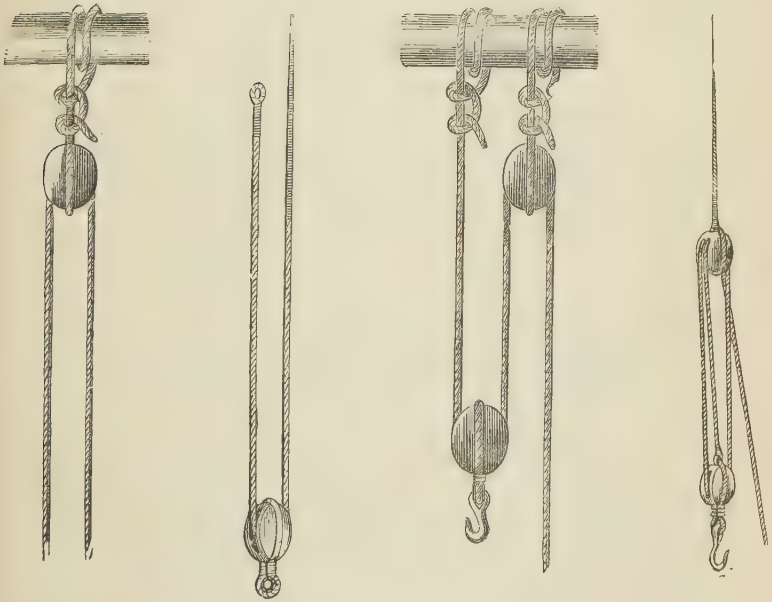
27. Rackings on the Lanyard.—Are taken off at first to bring an equal strain on all parts; and, when everything has settled well into its place two or three seizings are put on every two parts, that when the ship, working heavily, slackens the lee rigging and brings up again with a jerk, the strain may come at once on all parts of the lanyard, and not on each part in succession.

28. Tackles.—The power gained by them is as the space travelled over as you walk the weight up, to the space travelled by the weight at the same time, which, in simple tackles is as the number of parts at the movable block. For instance, in a single whip no power is gained, the direction only being altered for convenience in working. In a double whip the power is doubled ; in a gun-tackle purchase, with the standing part at the movable block, the power is trebled ; and the same with a luff or button, with the double block stationary ; in a side tackle with two double blocks, the power applied is increased fourfold; and so on. In a port-tackle fall, it is first of all doubled by the runner, then trebled by the tackle, which gives $2 \times 3 = 6$, the whole power gained. In a runner and tackle, $2 \times 4 = 8$; that is, five men on this purchase will lift as much as forty men on a single rope. Luff upon luff gives an increase of 16 times ; another luff added, 64 times ; and so on. But this is purely theoretical, and, for practical purposes one-fourth should be substracted for ordinary tackles, and one-third for a three-fold purchase, as an allowance for friction; and when the hauling part, coming from the movable block of a tackle, is not parallel to the tackle, there is a further loss of power = tension on hauling part × cosine of the angle.

One great advantage of a tackle on board ship, which renders its application of constant occurrence when mere power is not wanting, must not be overlooked ; as, for example, when sudden hoisting or jerking is to be avoided, and a steady, gradual strain, is required, as in staying a mast. Another advantage of a purchase, when fitted to any part of a ship's rigging, is that on *coming up*, when some little must

necessarily be given back, only a mere fractional part is lost on the rope itself; as in the lanyard of a dead-eye, the purchase fitted to an after main brace, &c.

The annexed plates shew the various tackles in general use on board ship.

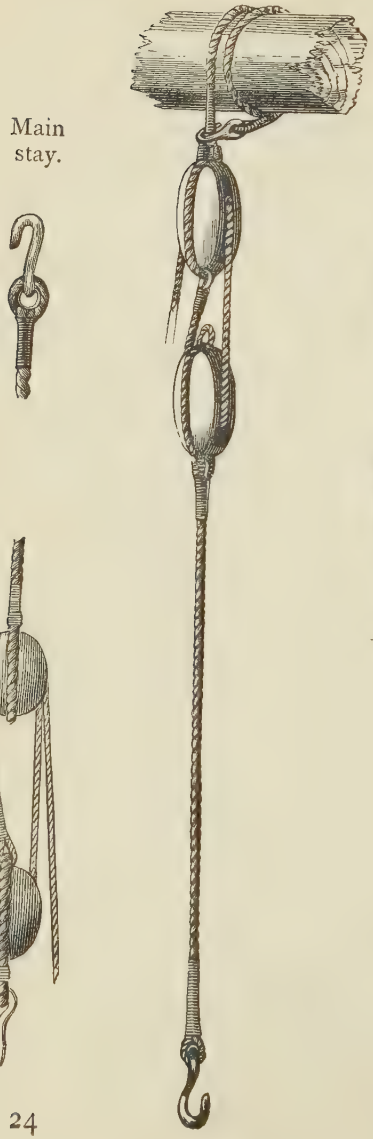


Quarter tackle.

Lower lift purchase.

Main stay.

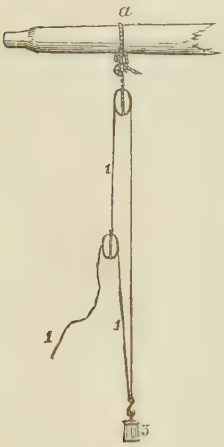
Top-gallant halyard purchase

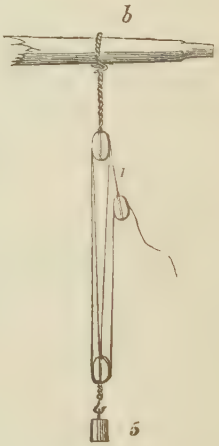


Luff. Top burton. Up-and-down. Runner and tackle. Sail tackle. Gun tackle purchase.

29. Spanish Burtons.—A single Spanish burton, *a*, has two single blocks, the standing part spliced into the strop of the movable block, and the bight seized or bent to the hook. This increases the power three times.

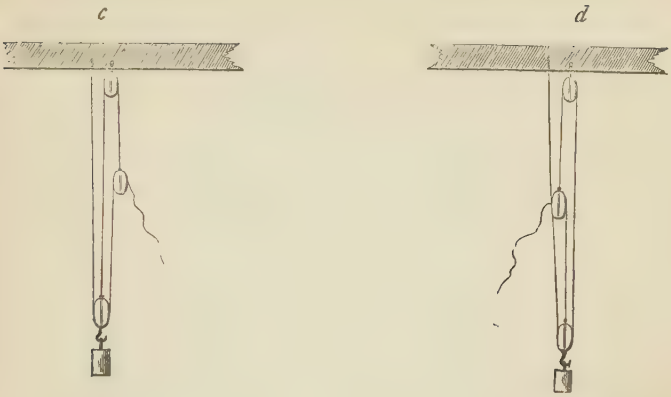
The double burton, *b*, has one double and two single blocks; the standing part spliced into the strop of a single block, then rove through the double or fixed block, and the bight seized to the strop of the lower block, to which the weight to be lifted is hooked. The end is then rove up through the double block, through the lower, and lastly through the single block to which the standing part is





secured. This purchase gives an increase of five times the power applied.

Other Spanish burtons, *c d*, are formed of single blocks which quadruple and quintuple the power respectively.



30. Standing part of a Tackle—Should be on the side of the block, opposite to the hauling part, as it thus leads fair, and counteracts the tendency of the hauling part to slue the block.

31. To find what sized Rope you require, when rove as a Tackle, to lift a given Weight.—Divide the weight to be raised by the number of parts at the movable block, to obtain the strain on a single part; add one-third of this for the increased strain brought by friction and reeve the rope of corresponding strength, which may be ascertained by the practical rule given in 220.

One-sixth of 40 tons is $6\frac{2}{3}$ tons, which, with one-third added, is 9 tons nearly; for which you should reeve a 6-inch or $6\frac{1}{2}$-inch rope.

Conversely:—To find what weight a given rope will lift, when rove as a tackle;—multiply the weight that the rope is capable of suspending by the number of parts at the movable block, and subtract one-fourth of this for resistance.

8·9 tons, the strength of the rope, multiplied by 6, the number of parts at the movable block, minus 13·3 or one-fourth, gives 40·1 tons as the weight required.

32. To Find the Loss of Support caused by the angling of a Stay.—Sine of angle × tension = effective force, which in this case, will be found to be 5·8 tons, showing a loss of nearly one-third.

33. Distance of Ratlines apart—Is fifteen inches: catch-ratlines every fifth.

34. How seized on.—Splice the seizing of two-yarn nettle-stuff into the eye of the ratline; pass it round the shroud, through the eye, *back* round the shroud, and so on; the eye lying athwartships.

The hitch crosses outside, for, when you stand on the ratline, it remains firmer, bearing against the shroud, than if hitched inside.

35. The Clove-hitch of the ratline should be formed so that the upper part of the hitch should lead aft to the next shroud. This will cause the line of the ratline to follow the sheer of the ship.

36. Squaring Ratlines.—In this case take two or three turns in the lay.

Chapter II.

BOWSPRIT.

37. Gammon a Bowsprit after the old method.—If there are two gammonings to be passed, which is the case in large ships not fitted with running in bowsprits, the outer must be passed first, or, from its greater leverage, it would slacken the inner.

The gammoning is chain, and the standing part is shackled round the bowsprit, close down to the after part of the saddle ; which, with the hole in the cutwater should be well greased. A turn is then passed through the hole in the cutwater at its foremost part and hove taut, as many thoroughfoot turns as can be taken are passed ; each turn as it is passed is hove as taut as possible with a pendant, and strong purchase brought to a capstan and racked by driving nails through the links into the bowsprit. The end is expended in racking turns passed up towards the bowsprit, and the whole is covered with lead.

If thoroughfoot turns were not passed, the outer turns would first feel the effect of the bowsprit working with the pitching of the ship; but, by the inner turns on the bowsprit becoming the outer ones in the cut water, the strain is equalized: also with a bowsprit of much steeve, the turns would have a tendency to slip down, if passed round and round.

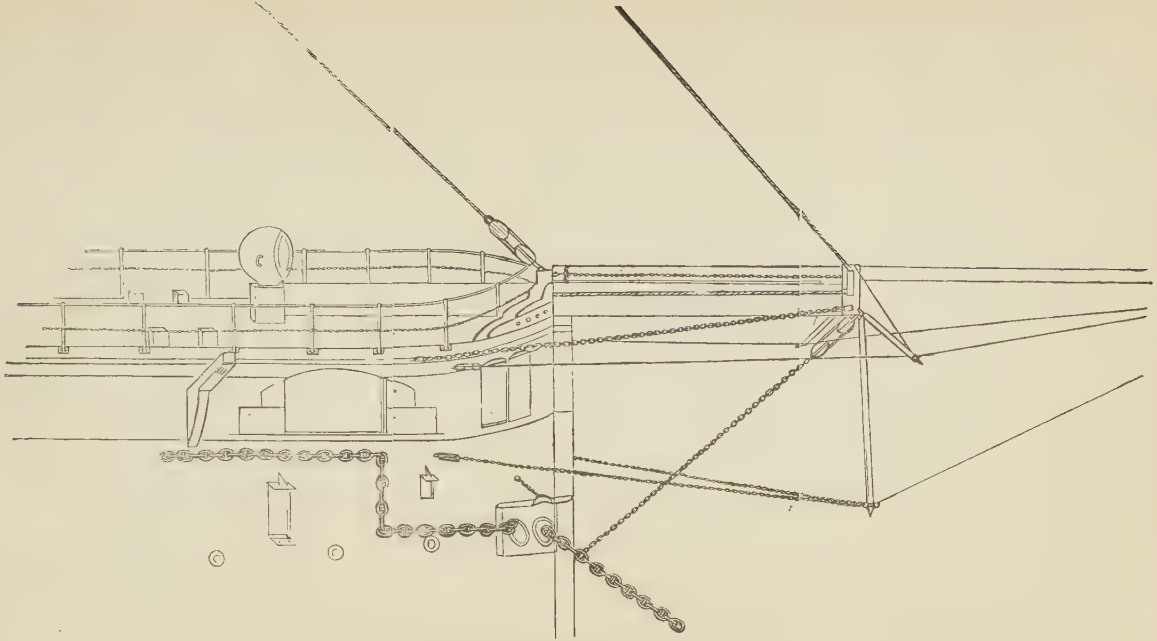
Iron bands screwed down over the bowsprit to the knightheads, take the place of gammoning in modern ships.

38. Clothe the Bowsprit of a Modern Ship.—The bowsprit cap is iron with bolts for the whiskers and dolphin-striker on it, also two snatches or iron bound sheeves for the fore topmast stays to reeve through, two spurs project from the cap for the rigging of the jibboom to rest upon when shifting jibboom, iron bands with iron bound hearts are secured round the bowsprit for the bobstays, and similar iron bands with lugs for the bowsprit shrouds.

Bobstays and bowsprit shrouds are wire or chain and are secured generally with shackles, slips, or screws to the bows and to the bowsprit.

39. Bobstays.—The inner bobstays are set up before those further out, otherwise you would be unable to work at the inner ones.

40. Setting up a Bobstay.—The single block of a luff is hooked to a cat's-paw in the lanyard, the double block to a selvagee round the bobstay, the hauling part through a leading part on the bowsprit—led inboard, on to which another luff, or up-and-down, is clapped along the bowsprit.



A RUNNING-IN BOWSPRIT.

41. Running in Bowsprits.—Ships intended to be used as rams, are usually fitted with running in bowsprits, which are of wood, and four-sided, the heel is kept in place between bitts fitted on the forecastle and with a slip fid ; chocks are bolted to the knightheads, and the bowsprit runs out between them over a roller let into the stem head, and is kept down by an iron band which goes over it, screwing down to the chocks.

The bowsprit cap is iron, with bolts for the whiskers, and dolphin-striker on it ; also two snatches, or iron-bound sheaves for the topmast stays ; inside the cap are iron-bound hearts for the bowsprit shrouds and bobstay to set up to.

Bobstay and bowsprit shrouds are chain, and the standing parts secure with slips to the bows, setting up to the bowsprit with a lanyard in large ships, but in some small vessels they are simply fitted with screws, which can be tautened up at pleasure with a lever.

Chapter III.

LOWER YARD, TOPMASTS, &c.

42. Getting in Main Yard from the Jetty.—Ship lying starboard side to the wharf. Reeve the jeers with the standing part aloft, leaving a sheeve out of the upper block, and take them to the capstan, or if more convenient, through a block at the edge of the wharf. and take them to one of the capstans at hand. Hook up-and-downs to strops out on the quarters of the yard ; and to the slings hook a sail-tackle taken to a bollard ashore and hauled taut. Bend a single guy to each yard-arm, take a turn with them and heave round the jeers. Pull upon the port up-and-down, to clear the fore rigging and ease away the port guy, holding on the starboard guy and sail-tackle. When clear, sway the yard across the nettings with the jeers and starboard tackle, easing and working the guys as necessary.

43. Main-Yard in the Water Alongside.—Coming in on the starboard side, haul the yard up with the port yard-arm forward ; lash the jeer blocks to it, and reeve the jeers in the foremast or port block, and secure the standing part round the yard, making three parts.

A jibboom, or mizen topmast may be used as a derrick, the former will probably be found the most convenient. Get up the largest hawser your jeer and top blocks will reeve; use an up-and-down for a derrick topping lift, with its double block lashed to one of the masthead pendants; hook a top block to the other pendant, reeve the end of the hawser through it, through a top block lashed to the derrick head, through the starboard jeer block on the yard, and secure the end outside all at the head of the jibboom.

Raise the derrick with the up-and-down, lash the heel, and put a luff on as a martingale.

Get a sail tackle on the foremost yard-arm as a guy, a rope's end will be sufficient for the after arm. When all ready, sway the yard clear of the netting, with the hawser, taking down the slack of the jeers, then haul away foremost guy and jeers, ease the hawser, and when the yard is athwartships, land it on the netting. If necessary, use top burtons as preventer lifts in placing the yard. Reverse the operation in getting the yard out.

Another method which is often adopted when this evolution is performed as a "Drill" exercise is as follows:—

Use jibboom as a derrick; the standing eye of a wire martingale is first placed over the head of the jibboom, a luff being hooked to a thimble in the other end and set up through a lower deck port; 5 wire strops fitted with thimbles, are then placed over the jibboom, and to these are hooked or shackled the tackles used; for guys use two sail tackles, for topping lift an up-and-down from the masthead pendants, for the main purchase use the top tackle blocks and cat fall,

the fall being led through a leading block at the derrick head and then to a block at the lower cap ; raise the derrick with a burton from the quarter of the topsail yard, secure the heel by the main bitts with luffs and lashings, reeve 3 parts of the jeers, shackle on main purchase to slings of the yard and when ready sway away, rig the yard arms from the nettings, when high enough man the jeers, slew the yard athwartships and sway right up.

The fore derrick guy may be fitted with a long wire pendant, a standing eye over the derrick head and a thimble in the other end for the sail tackle to hook to, it is then easily unhooked and dipped over the yard if the yard is being got outboard.

44—Rig a Main Yard —The *slings* consist of two pieces of chain, the foremost ends connected to a large ring, through which the after ends reeve ; these join in a long link to which the ship is attached. A more usual and modern fitting consists of an iron band with lug and shackle on top to which the slip is attached.

Jeer Blocks—Are single blocks fitted with two single strops of different lengths, to allow the sheeves to lie fore and aft ; the foremost strop is the shortest, and the strops are lashed together with a rose lashing on the upper fore quarter of the yard. A more usual and modern fitting is for the blocks to shackle on to iron bands round the yard. The short jeers are sometimes kept rove as preventer slings.

Truss strops.—Are chains, with their end links lashed on the top of the yard ; one of them on each side has a fair-leader for the hauling part of the truss, the standing parts of

the truss shackle to the other truss strops on opposite sides. A more usual and modern fitting consists of iron bands with lug and rounded shackle on the after part of the yard through which the truss chains reeve or are secured.

Topsail sheet blocks—Are iron rollers or fair leads secured by iron bands round the yard; there are generally two or three of these fair leads along each side of the yard.

Clew-garnet blocks—Are stropped with sennet tails going round the yard, the block lying well up on the quarter. The standing part of the clew-garnet is secured with a timber hitch round the yard outside the block.

Quarter strop—Is a single wire strop round the yard with a thimble seized in on top of the yard.

Yard-arm rigging.—An iron band with four lugs or eye-bolts is placed over the yard-arm, the lower lift which is single and wire is shackled to the upper lug, the preventer main brace block and the after main brace block to the foremost and after lug respectively, the wire jackstay which is fitted with a small standing eye is placed over the upper lug before the lift is shackled on, it then reeves through the jackstay bolts on the yard, and lashes to the end of the opposite jackstay in the bunt. The head earring strop is fitted round the same bolt, the footropes are fitted with clip-hooks which hook to a bolt at the yard-arm, a small eye is fitted at the other end; at convenient distances the foot-rope is kept up by stirrups, through which it is rove, their upper ends going over the jackstay bolts.

The yard tackle pendant—If fitted, is wire, and one quarter the length of the yard, with a fiddle block in the

lower end, the upper end is either spliced into a dog strop round the yard-arm or fitted with a hook to secure to a lug in the iron band round the yard.

Brace blocks—Are fitted with double strops and shackle to the lugs in the iron band round the yard so that they lie with the sheeves horizontal.

The leech line blocks—Two on each side before the sail are tailed and hitched to the jackstay; from these the leech lines reeve through a double block secured under the top, and thence down on deck—abaft. *The slab-line blocks*—two on each side abaft the sail are secured like the leech-line blocks, and the slab-lines when rove through them, lead down before the mast through small double blocks. At the length of the yard-tackle pendant in from the yard-arm there is a block for the quarter tricing line, and the bill tricing line is rove through a block on the slings.

45. Lower Brace Block.—The side which has the square head of the bolt in it is the uppermost, to prevent the bolt working out.

46. Difference between lower and topsail brace block Strops.—A lower brace block is fitted with a double strop, topsail brace block with two single strops. The former —to make the block lie horizontal, the latter—vertical.

47. Difference between Fore and Main-topmasts.—In a fore topmast, the live sheeve is cut from the port after quarter to the starboard fore quarter, and in a maintopmast, from the starboard after to the port fore quarter.

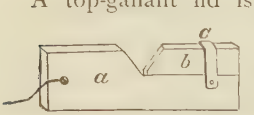
48. Heels of Topmasts and Top-gallant masts.—If a spar were used large enough to allow the heel to be cut out

of the solid, the most important part of the mast would be formed of the core, thus a mast of this description would be considerably weaker than one formed of a smaller spar : and moreover, as the younger a spar is, the greater is its comcomparative length, owing to its greater compactness (which may be seen by comparing the specific gravities of large and small timber), so the greater is the inducement to employ small spars when applicable for this purpose.

49. Shoulder for the Cap, on three Sides of a Mast-head.—This allows you to make the after side wedge-like by giving more to cut away on ; and this form prevents the cap from drooping forward and also from jambing.

50. Fids.—A topmast fid is of solid iron, with a hole in the end through which is spliced a strop for a jigger to hook to for unfidding—assisted by the top maul.

A top-gallant fid is composed of *a*, the fid, and *b*, the shoe. An iron band *c*, with a pin through the fid, keeps the shoe in its place. The upper part of the fid hole in the mast is cut so as to dovetail in between the fid and the shoe. By the working of the mast it is therefore impossible for the fid to work out.



51. Getting Main topmast on End.—Lying on the starboard boom with head aft. Hook the top blocks, reeve a 7 inch hawser through the starboard block, overhaul it down and hitch it through the live sheeve round the heel of the mast, and pass a lashing round the head of the mast and hawser about a third down. This drift is necessary to allow the masthead to be swayed up outside the top (being hauled for-

ward by a main top bowline,) should it be requisite to lower it down the main hatchway previous to pointing its head between trestle-trees. Get up and lash the starboard fore up-and-down, and hook it to a strop through the fid-hole. Brace the main yard sharp up on the starboard tack, bring the hawser to the capstan and run it round, easing away the fore tackle. When the topmast is up and down the mast, land it on the deck, unhook the fore tackle, steady the head, slack up the lashing, double the hawser, and sway up high enough to reeve the port top-tackle pendant over the dumb sheeve—well smothered in grease, the upper block being rounded close up to the futtock rigging. You are now ready to sway away and fid.

It may be swayed up from alongside in the same manner.

52. GETTING A LOWER CAP OVER.—Main. Sway a top block up by one of the gantlines, and lash it on the starboard side of the masthead ; reeve a 7-inch hawser through it, overhaul it down, bend on, and sway the cap into the top—(outside all, guying it clear by the fore-and-after, for it will not come up through lubber's hole), and place it fair for receiving the head of the topmast. Then overhaul the hawser down again, get the topmast up and down, double the hawser—rove through the live sheave, and, if high enough, lash the cap, by middling the lashing, clove-hitching it round the masthead over the cap, reeving each end through the foremost bolt in the cap, its own side—round the masthead, through the after bolt in the cap, back round the masthead, and so on till enough turns are passed. Place a capstan bar in the fid-hole, with a slew rope bent to it ; sway away, slew the topmast, and lower until the cap is on, when place the capshore.

The same means are employed for sending the cap down, but the capstan bar, slung by one of the gantlines abaft the masthead, is used for a bumper; the gantline worked on deck.

53. Sending topmast Crosstrees over.—Main. Sway the topmast six or seven feet above the cap, and lash the gantline blocks on each side of the topmast head well up. Up end the cross-trees abaft the mast, as in sending a top over, bend the gantlines, led underneath, to the after horns, close to the trestle trees, and stop them up to the foremost horns. Bend a guy from the mizen-mast-head to the fore part, to keep them clear of the top, sway away, and land them on the cap. Bend a couple of bell-ropes to the foremost horns from the top, to steady them, cut the stops, lower the topmast, haul over on the bell-ropes; keeping a strain on the gantlines, and the cross-trees will fall over the mast-head; then unlash the gantline blocks, and let the cross-trees come down into their place.

54. Sending topmast Cross-trees down.—Strip the mast, sending down the cap and hanging blocks, unfid and lower it until the cross-trees are one fathom from the cap. Stopper the hawser, and belay it with two fathoms slack—(the distance of the cross-trees above the cap being measured and sent down from aloft to guide you). Off stopper, and bump the cross-trees to start them. Lower the mast and land them on the cap. Pass the ends of the lower masthead gantlines over the lower lift blocks:—from aft, forward (main topmast cross-trees), and bend them to the cross-trees. Bend one of the fore gantlines or main-top bowline, to the fore part; haul taut the gantlines and take a turn with them. Ease the

cross-trees down off the cap—(the gantlines lying over the lift blocks preventing them falling far), haul forward on the bowline and when clear, lower away. Lower the fore topmast cross-trees down abaft, with one of the main gantlines for a fore and after.

55. Rigging and staying fore Topmast.—After the cross-trees are on, the topmast is rigged in the following order ;—necklace, bolsters, grummet, burton pendants fitted with a cut splice, starboard foremost pair of shrouds, port foremost pair of shrouds, starboard after pair of shrouds, port after pair of shrouds, starboard pair of backstays, port pair of backstays, topmast stays fitted with a fork and two lashing eyes, sail tackle pendants fitted with a horse shore splice.

The Necklace.—Is a chain strop round the masthead under the bolsters with short legs on each side, the hanging blocks, and jib and foretopmast staysail halyard blocks shackle to these legs, also a block for the jib stay to reeve through, as in nearly all cases the jib stay is fitted with a slip at the jib-boom end, it then reeves through this block and is set up on deck with a purchase by the foremast.

A necklace is not always fitted, but iron bolts attached to the frames of the cross-trees with long hanging links of chain take its place.

To send the rigging over, shift the gantlines to the after horn of the cross-trees and put the rigging over in the same manner as lower rigging, only in the order given above.

The rigging is all wire.

The sister blocks may be seized in between the foremost shrouds below the seizing before sending them over, but this

is not a good fitting, for reasons given in Art. 57 ; a far better fitting is two pendants fitted with a horse shoe splice and fiddle blocks attached, this is then put over the mast-head before the burton pendants.

The rigging being over, the topmast cap on, and hanging blocks shackled, fid the mast, get up and steady taut the sail tackle, hook the top burton to the pendants, stay the mast and proceed to set up the rigging. For which use a runner and top burton ; the runner fitted with a selvagee tail on one end, and a thimble on the other, rove through a block stopped with a thimble ; the lanyard is bent to the thimble ; the tail of the runner clapped on the shroud, and the single block of the burton hooked to the thimble of the pendant ; pull up and beat down the shrouds successively, fleeting the runner as required to each shroud, and then to the backstays. The topmast cap may either be sent over by gantlines on the topmast head, bent to the foremost bolts, and stopped up to the after, going up before all, or else, the mast lowered after the rigging is sent over, and the cap placed on the top of the rigging, fair for swaying through.

56. Sister Blocks in Topmast Rigging.—The foremost pair of shrouds were seized together with a stout seizing ; the block then put in, and secured in its place by slighter seizings round it and the rigging.

57. Lead of Topsail Lifts and Reef-Tackles.—When the yard is braced forward, these ropes lie right across the cheek of the block,—a most injurious lead when hauling out the reef-tackles in a gale of wind, and the yard is obliged to be braced by, or at all forwards.

58. Rigging a Topsail-yard.—The yard in the centre has two iron bands, with eyes on the top of the yard, to which the halyard blocks shackle.

Parrall.—A wire or chain strop covered with leather which shackles to two iron bands round the yard.

Quarter strop.—A single wire strop spliced round the quarter of the yard with a thimble seized into it, is used for hooking the sail tackle to when sending the yard up or down. A small wire pendant is sometimes fitted, connecting the two quarter strops together.

Quarter Blocks. – Are single blocks, with single wire strops having an eye in each end and lashing on top of the yard with a rose lashing.

Yard-arms.—An iron band fits round the yard with eye-bolts on it, to which the lift and brace blocks are shackled, the jackstay is wire and is fitted with a small standing eye to go over the eyebolt to which the lift is shackled, the head earring strop is a small wire strop and thimble attached to the same bolt, the footrope is fitted with cliphooks which hook over the gooseneck.

Foot-ropes.—Are fitted with cliphooks which hook over the gooseneck, then through the stirrups, and seized to the yard on the opposite quarter; turks-heads should be worked on each side of the stirrup, as they prevent the foot-ropes falling into long bights; and if the latter carry away, they will not unreeve to the hazard of men's lives.

Jackstays.—Are wire fitted with a small standing eye that fits over the eyebolt in the band at the yard-arm; they then reeve through eyebolts on top of the yard and lash together in the bunt.

The top-gallant sheets reeve through snatch cheeks at the yard-arms.

The reef tackles reeve through sheaves at the yard-arms, but owing to the chafe caused to the rope in passing through the sheave and the heavy pull when it is blowing fresh, the rope often carries away; to obviate this a block shackled or stropped to a long link round the gooseneck may with advantage be used for the large reef tackle, still keeping the small reef tackle rove through one of the sheaves in the yard.

59. Rigging of Jib and flying Jibbooms, Whiskers, and Dolphin-striker.—*Jibboom*:—Heel secured by a heel chain shackled to a bolt in the cap, placed in the score, and secured with a slip shackle to a bolt in the other side of the cap: the heel rests in a saddle, and is kept down by a chain crupper, also fitted with a slip shackle. A funnel generally goes over head of the boom on which the rigging is placed in the following order:—Martingale, footropes, guys, jackstay, flying boom-iron, fore top-gallant stay. (The latter reeves over score in jibboom.)

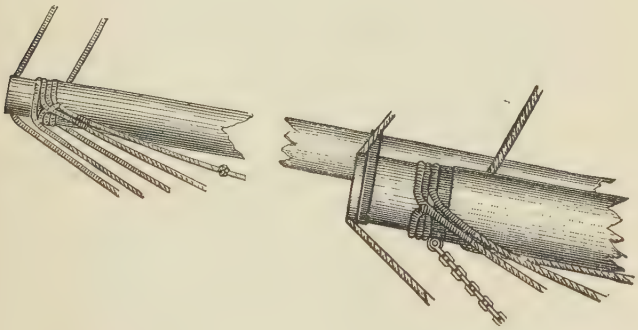
The Martingale—Is chain, one end is shackled to an eyebolt on an iron band round the funnel, the other end to an eyebolt on a band round the dolphin-striker.

Foot-ropes—Go over the funnel with a cut splice, then stopped out to the guys, and the after ends lashed to bolts in the cap.

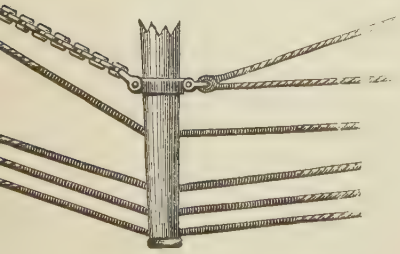
Jib-guys—Are fitted with a standing eye over the jibboom and a half-crown over the whisker end, the after end then setting up with a purchase to a bolt in the bow.

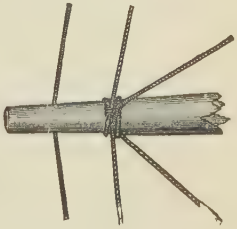
Jackstay—Is fitted with a standing eye over the jibboom and sets up to the bowsprit cap.

Flying-boom—Foot ropes, guys, martingale, and fore royal stay in the score. These are fitted as in a jibboom; a hide funnel may be used with advantage, the rigging being sewed to it.



Spritsail gaffs or Whiskers.—Jib-guy, jumper, lift, flying-guy through a hole in the whisker-end, and half-way in, there is a block for the flying jib-sheet. The jib-guy is fitted with a half-crown over the whisker-end and sets up with a purchase to a bolt in the bows. The jumper is fitted with a standing





eye, then rove through a clump block on the cutwater and set up with a purchase to the bows. Lift, with the standing eye, and sets up to a bolt in the cap. Flying guy, with a purchase to the bows. The fore guy (of lower boom) some times reeves through a block on the whisker-end.

Dolphin-striker.—A sheave hole a few feet below the bowsprit for the jibstay to reeve, if it is fitted as a reeving stay. An iron band is placed over a few feet from the lower end, to which is secured the jib martingale and the back-ropes; between this band and the extreme end are four sheaves through which are rove the following ropes in order, commencing with the upper sheave, fore top-gallant-stay, flying jib-stay, flying jib martingale, fore royal stay.

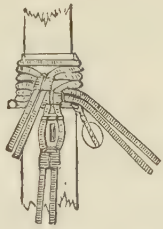
60. Rigging of fore Top-gallant and Royal Masts—The flying jib halyard block strop first goes over the funnel on the top-gallant-mast-head; then fore top-gallant stay with an eye splice; flying jibstay the same; starboard and port pair of shrouds and starboard and port pair of backstays, the foremost generally fitted as a breast backstay: over the rigging are lashed the blocks for top-gallant studding-sail halyard.

Top-gallant rigging should be set up on the bight; the general plan is as follows:—the two shrouds after leading down through the rollers in the horns of the topmast cross-trees are led across to the opposite side of the top, then toggled together and set up with a purchase to the top, the fall being led down on deck.

All top-gallant and royal rigging is wire.

Royal-mast.—Stay; starboard pair of backstays; port pair of backstays;—the foremost as breast backstays; truck.

A false royal mast-head, hollowed out to receive the top of the royal pole, which is cut away to fit into it, is used ; the



rigging and truck are placed on it, and consequently are not disturbed when shifting the mast.

A practice occasionally followed is to split the head of the royal-mast sufficiently to allow the bight of the royal yard rope to unsnatch when the mast is lowered, instead of unreeving it.

61. A Top-gallant Stay—Being placed below the rigging allows the royal to be cut with less roach than it would have if the stay were above.

62. Jacks and Jack Blocks.—Jacks are small iron horns, projecting from an iron band, which is bolted to the rim of a top-gallant funnel. They are principally intended to stand on when crossing royal yards, &c., and are of great assistance in slueing the rigging square when sending up top-gallant masts. The iron band being fitted with eye-bolts, the span blocks, top-gallant buntline and flying-jib halyard blocks can be shackled underneath the rigging ; which considerably lightens the appearance of the masthead. The horns are curved aft to keep clear of the royal when set ; and the iron band on the hounds of the top-gallant mast is notched on the fore part, into which a tooth in the iron ring of the jack slips, insuring the funnel being properly placed.

Jack blocks are occasionally used to dispense with the necessity for unreeving the yard-rope, when shifting the mast; and are lashed round and underneath the rigging, the yard-rope being rove in them, instead of through the sheave in the mast.

63. SENDING STUDDING-SAIL BOOMS ALOFT.—Top-mast studding-boom;—Pay a rope's end down from the top, and bend it to the bolt in the heel; put a whip on the topsail yard to plumb the quarter-iron and bend it to the boom amidships, hitching the heel-lashing to it, to prevent it slipping out; stop the whip out to within three or four feet of the boom-ends, and sway away. Bear the boom-end clear of the topsail-yard, and, when the stop is up to the block, haul up as much as you can get of the heel-rope, take a turn with it, walk back the whip and land the boom across the quarter-iron; cut the stop, pull up on the whip and heel-rope, and launch the boom out.

A more usual plan is to overhaul the topmast studding-sail halyards, down on deck, bend it to the boom towards the outer end, then form a span by hitching the heel lashing round the halyards, overhaul the boom-jigger down and hook on to the heel of the boom, man the halyards and sway the boom up square, when high enough bear out, point the boom and secure.

Top-gallant boom.—Sway it up into the top, pass a gasket or end of an earring down from the yard-arm, and bend it to the boom end; toggle the boom tricing line, trice up and haul out.

Lower booms are got out abaft the fore rigging by a whip on the fore and main yards.

Chapter IV.

SAILS.

64. Sizes of Canvas.—

No. 1.—Is used for storm sails and courses
„ 2.—Fore and main topsails.
„ 3.—Mizen topsail.
„ 4.—Only used for repairing.
„ 5.—Fore and main top-gallant sails, fore topmast staysail; jib, and spanker.
„ 6.—Topmast and lower studding sails.
„ 7.—Mizen top-gallant sails, royals, flying jib, and top-gallant studding sails.
„ 8.—For repairing, and boats' sails.

Sails are repaired with the next sized canvas smaller than that of which they are made.

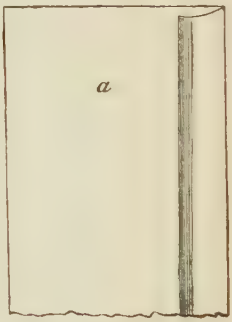
Canvas is made up in bolts 40 yards long.

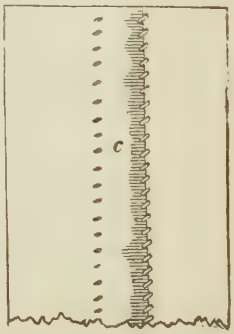
65. Breadth of Canvas.—Twenty four and eighteen inches. The latter is generally number 5.

66. Eighteen-inch Canvas.—It is used for the jibs and spanker, as great nicety is required in cutting them.

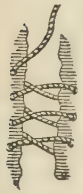
67. Canvas.—Each cloth is marked with a thin waved line of blue, being run up and down it.

68. Sewing Canvas.—Turn the right-hand edge of the first cloth, *a*, over *towards* you; equal to the breadth of the seam; then lay the next cloth, *b* (working to the right), on the top, and sew its edge to the double part of the first cloth—sewing always from left to right; rub the seam down, slue over, double the second cloth back from you, and in





the same way sew the edge of the first cloth to the double part of the second ; rub down, and it will appear as at *c*.



69. Herring boning.—Is used for stitching up rents and small holes in sails. You begin on the left side, sticking your needle up, then down on the right and bring the needle up inside the first turn.

70. Eyelet-Holes.—Marline is run along the after side of the sail, and formed in bights over holes stabbed in the canvas, thus :—

71. Breadth of Seams.—An inch and a-half for top-sails and courses, and an inch for top-gallant and smaller sails.

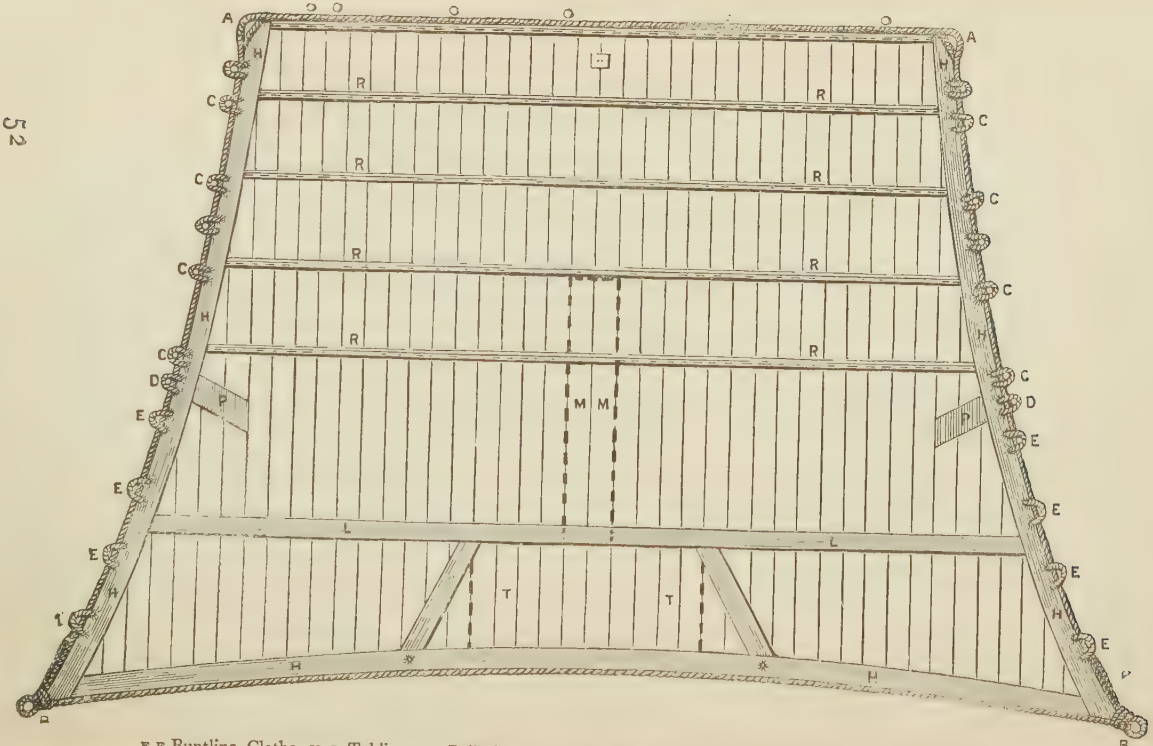
72. Dissimilarity in their breadth.—The seams of a spanker are wider at the head and foot than amidships ; in a jib they widen at the foot,—the advantage of which, in either case, is not palpable.

73. Middle-seaming.—Topsails, courses, and storm-stay sails are alone middle-seamed.

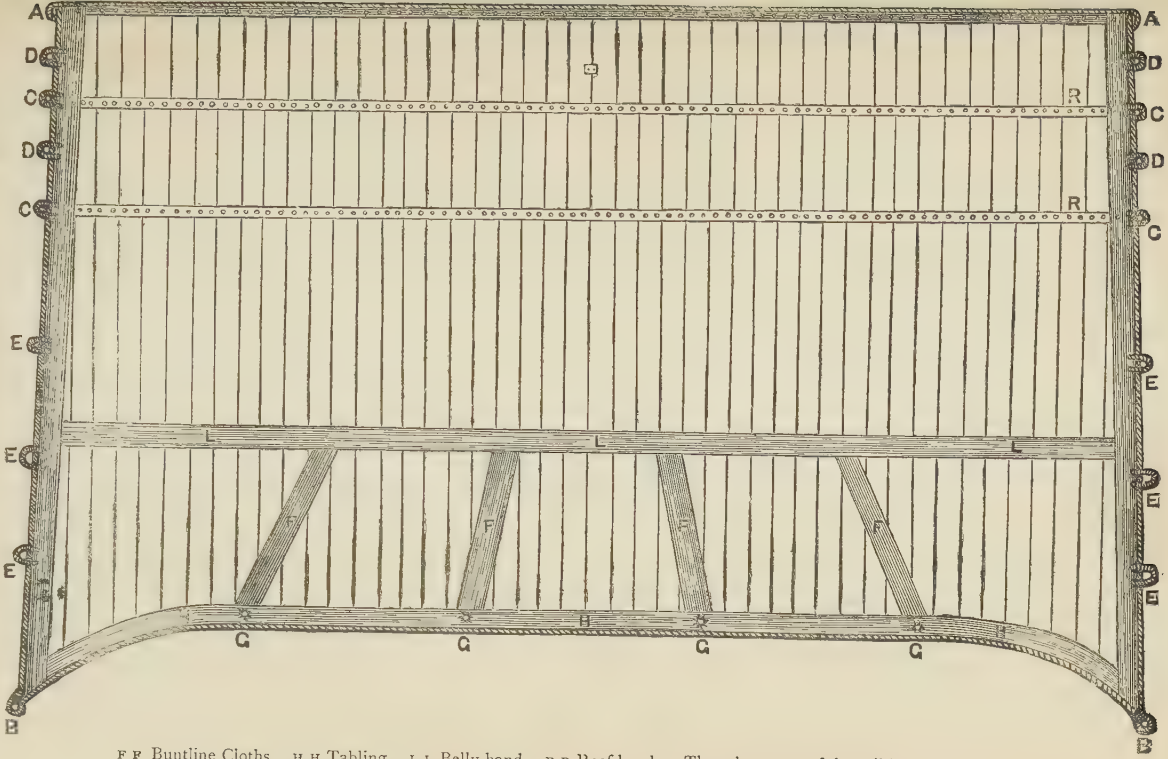
74. Sick Seams.—Are those in which the stitches are worn, and given way here and there.

(It is to be regretted that this, and many other expressive technical terms, are gradually falling into disuse.)

75. LININGS OF A TOPSAIL.—The upper corners are called the head earrings, and the lower the clews.



F F Buntline Cloths, H H Tabling. L L Belly-band. M M Mast-lining P P Reef tackle patches. R R Reef-bands, T T Top-lining. The other parts of the sail bear the following names :—A A The head A B The leech. B B The foot. C C Reef cringles. D D Reef tackle cringles. E E Bowline cringles. G G Eyelet holes for the strops of the buntline toggles.



F F Buntline Cloths. H H Tabling. I. I. Belly-band. R R Reef bands. The other parts of the sail bear the following names :—A A The head. A B The Leech. B B The foot. C C Reef cringles. D D Reef Tackle cringles. E E Bowline cringles. G G Eyelet holes for the strops of the buntline toggle.

77. Fit a topsail.—Stretch the head of the sail along, fit robands to the eyelet holes in the head ; the head earrings to their cringles. Along each reef band fit the reef-lines, and from the head down the reefs, fit spilling lines.

On the leeches fit third and fourth reef-earrings, bowline bridles ; span from large reef tackle ; beckets and toggles for small reef tackles. In the centre of the sail fit the beckets for the bunt whip, sew the gaskets on along the head ; splice the buntline toggle strops into the foot, and seize in the toggles.

To fit the reef-lines, a small line or *jackstay* is turned into the leech, level with the reef band, on the after side of the sail ; another line is then run along the fore side, through each eyelet hole, and round the *jackstay* abaft, hauling taut through each time so as to form a jambing hitch in the eyelet hole ; the ends are secured to the leech ropes.

Beckets and toggles must be fitted to the jackstay, on the topsail yard.

The two midship robands are always made larger than the others, to distinguish the centre of the sail in bringing to.

78. Fit a Course.—Stretch the head of the sail along, fit the head earrings and robands, put four toggles on the foot for the buntlines, and two on each leech both before and abaft all, for the leech and slab lines to toggle on to. A course has only two reefs, which should be fitted in the same manner as those of a topsail.

As a general rule the second reef of a course is not fitted, although the eyelet holes are worked in the sail.

79. Reefs of fore-and-aft Sails.—The points are *crow footed*; which is done by stabbing a hole in the sail, middling the point, and twisting it against the lay, so as to work the strands out into loops. Put one end of the point through the sail, keeping the loops on one side, which stitch to the sail—one bight being on the upper part of the hole, and the others on each side, and each point on a seam.

80. Bowline and Reef Cringles.—Reef cringles, and reef-tackle bridle-cringles have thimbles, which bowline cringles do not require.

81. Bowline Bridles.—That of the foresail has two cringles; mainsail three; fore-topsail three; main-topsail usually four. It is a good plan to have the toggle on topsail bowline bridles, fitted with a long drift, as it gives great facility for bending or unbending the bowline, in the top or on the lower yard.

82. Cringles in leech of Fore and Main-top-sails.—The number is the same in each; for, in the fore-topsail, the reef-tackle bridle hitches to a separate cringle; but in the main-topsail, to the upper bowline cringle.

83. Difference between Clews of Topsails and Courses.—Courses have a clew rope.

84. Head and Leech-ropes of a Sail.—The head cringle is first made by splicing an eye in the end of the leech-rope; the head rope is then passed between the strands of cringle, and spliced into its own part.

85. Leech and Foot ropes.—These are spliced together, just below the lower bowline cringle, with a sailmaker's splice.

86. Sailmaker's Splice.—When a large and small rope are to be spliced together, and they require tapering off to

blend their sizes, as in the leech of a topsail, a sailmaker's splice is used.

To form it; unlay enough of the small rope to put the ends in once and a half; but of the large one, unlay for a considerable distance, according to the relative disproportion of the ropes, and the degree of tapering you intend to give them; open out, and bring the parts together, as for a common splice.

Then take a strand of the large rope, cut away about a fourth—from underneath—and put it, *left-handed*, through the corresponding strands of the small rope; cut away a few more yarns, and pass it again, backhanded, *round the same strand* of the small rope; and so proceed—working with the same strand of the large rope, round and round the same strand of the small one, cutting away gradually till it is reduced to nothing. Then, one at a time, put the other large strands through in a similar manner, cutting away more or less of the third strand, as may be necessary to give roundness to splice. Finally, slue round and splice the small strands into the large rope, as in a common short splice.

87. Cut of Topsails.—If topsails had a straight leech a greater length of yard-arm would be required to take the reefs in.

88. Cut of Topsails and Courses.—Courses are cut with a roach, to clear the boats and hammock nettings; but topsails have a straight foot.

89.—Marks on Sails.—They show, in the case here stated, that the head is of $19\frac{1}{2}$ breadths, the foot of 29 breadths, and drop of the sail 12 yards.

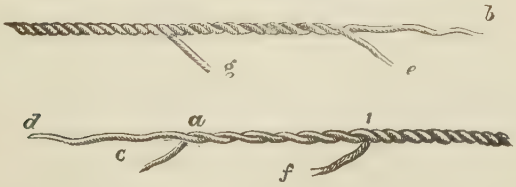
90. Reducing a topsail.—If not much reduction is required, a piece may be cut off the head, reducing the size of the first reef; otherwise, it must be cut at the belly-band to prevent altering the reefs, or lessening the spread of the foot.

91. Service on the foot of a sail.—Keeps the marline from being chafed.

92. Ropings of a sail.—Three in a jib—luff and foot leech, and clew-rope; two in a trysail,—head and foot, and luff, leach, peak-rope and clew-rope, of the same size; two in a topmast studding sail,—head and foot and leeches in one.

93. Lengthening a rope with an additional strand.—Cut a strand at 1, unlay until you come to 2, and

cut another strand; unlay both to 3 (equal to the distance from 1, to 2, or thereabouts), and there cut the last strand; separate the parts and they will appear thus :—



Measure off the increased length from 1, mark it *a*, and bring the end of the left-hand piece *b*, down to *a*, and lay it in. The second strand at 2, must have been cut sufficiently far

from *a* to allow end enough for knotting and laying in. Twist the ends *c*, and *b* up together, ready for knotting on finishing the splice, and *d* and *e* in the same manner for the present: the splice will then have the following appearance:—

Cut a piece of rope, and unlay a strand sufficiently long to fill in the vacant lay between *f* and *g*, and to knot with the ends, *f*, *g*; lay the strand in, and finish off as with an ordinary long splice, from which it will only differ in appearance by its having four breaks in the rope, instead of three. In putting in the long strand care must be taken to follow the lay along correctly, or it will not tally with the ends, *f*,*g*, with which it knots.

94. To shorten a Rope in the Centre.—Proceed precisely as in the previous case; but, instead of separating the strand *b* from 1.—bringing it down to *a*, *take it up* on 1 as far as you require to reduce the rope. No additional strand is used, so knot *b*,*f*; *d*,*g*; *e*,*c*; finish off the ends, and in appearance it differs in no way from the common long splice.

Chapter V.

REEVING ROPES, FITTING GEAR, &c.

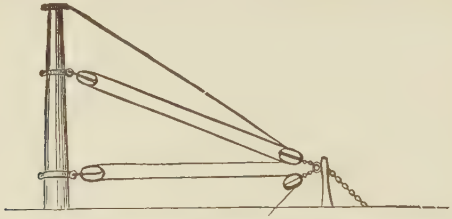
95. Rigging fitted by the Dockyard.—Everything is drawn ready fitted, according to establishment,, from lower rigging to a top-gallant studding-sail-halyard block-strop. Tackles and other gear are not rove, but all the blocks are stropped.

96. Fitment of Yard and Stay-tackles.—In stropping the lower blocks a good drift should be given between the block and hook, for convenience in hooking and unhooking and slueing it; and a seizing passed below the block, and another above the thimble.

The stays should have a short strop with a thimble seized into it, rove between these seizings, to hook the yard tackle to, when necessary.

The standing part of the falls should be rove through a becket in the upper part of the block, and then slipped over the strop below the block with a running eye spliced into the end, that the standing part may be dipped when turns come in the fall.

97. Fitment of Boom Sheet.—Two single blocks on each side of the boom, the first just outside the rail and the



second half way between that and the boom-end. An iron spur, on each quarter, with an eye in the end, through which is rove a chain, shackled to a bolt in the quarter, with two short legs on the other end. To the foremost leg a single block is shackled, and to the after one a double block. The fall is then rove, and the standing part spliced into a bolt in the hoop on the boom end.

98.—Reeving one Rope by another. Put the ends of the two ropes together, and worm three yarns or pieces of spunyarn between the strands for two or three inches on each side, clove-hitching the ends round the rope, or opening the strands and laying them in.

99. Reeving a new Coil of Rope.—Dip the end up through the centre, and thus a turn is taken out of every fake.

100. Lacing of a Stay-sail.—Is rove round and round against the lay of the stay, or the lacing would get into it and hold the sail on setting, or taking it in. With a jib the lacing is rove through all the eyelet holes in the sail and seized to each one, whereas with a stay-sail the lacing is only rove through every other eyelet hole, the bight of the lacing being brought over the stay and seized to the vacant eyelet hole. Wire lacing is used.

The disadvantage of much lacing consists in the frequent liability of one part to get over the other, which prevents the sail hoisting or coming down; and the objection to many hanks is that the head of the sail will not stow close down.

101. FITMENT OF STORM STAYSAIL-STAYS.—The fore staysail stay is fitted with a fork and lashing eyes, the eyes lash or shackle together abaft the mast and the stay is set up to a bolt in the stem.

A neat fitting is to splice the upper end round a small iron toggle which can then be rove in between the forks of the fore stay, the lower end setting up as before.

102. FITMENT OF STAYSAILS.—A fore staysail may be brought to, with beckets made as follows :—Into one end of a piece of rope splice an eye, large enough to take a matthew-walker formed in the other end; and when this is done, the becket should be long enough to go from one eyelet-hole, round the stay, and opposite the next hole, not binding the sail too taut to the stay. Then, beginning at the head of the sail, reeve the beckets, against the lay, round the stay, and the eye put over the knot of the next becket; and so on until all are passed, all the knots lying on one side. The halyards are double, and reeve through a block at the mast-head; downhaul as in other sails; tack lashed to a bolt in the stem.

The main topmast-staysail is fitted with throat brails, clew tricing-line and downhaul, and sets on the topmast stay.

The top-gallant staysail sets on the top-gallant stay, when the stay comes down to the lower cap; but, if to the topmast head, a staysail stay must be fitted. It is taken in with a downhaul, and stows up and down the foremast head to its own stay.

The royal staysail-stay is clenched round the main top-gallant mast-head, reeves through a clump block (which travels with a thimble seized into the strop up and down a jackstay), and thence down on deck. This jackstay is fitted with a running eye round the fore topmast-head, and sets up to the cap : a tricing-line is bent to the clump block, reeves through a block at the topmast-head, and then down on deck ; the downhaul block also lashes to the strop of the clump block. The sail is set by tricing it up to the topmast-head, and then setting the stay up. When taking it in, after the sail is hauled down to the clump block, the tricing-line is lowered, and the sail and stay are hauled down to the lower cap. It is then stowed up and down the lowermast-head, with the top-gallant staysail in one, covered ; and the centipede passed.

A netting of small rope laced between the man ropes on the bowsprit, is sometimes used to stow the fore topmast-stay-sail on ; and is both neat and serviceable.

103. Topsail-tyes.—Are cut long, to send the yard up and down by, in addition to the sail-tackle. This is seldom done now, two sail tackles hooked to the quarter strops being used to send the yard up or down.

104. Topmast Studding-sail Halyards.—Lead before the yard ; for the sail, when set, having a forward tendency, would of course bind the halyards if rove abaft.

105 Lacing of the lower part of the luff of a Spanker.—Is spliced into the upper cringle, passed round before the mast, through the next cringle, *back round the mast*, and so on to the bottom. If rove round and round like the lacing on the head and gaff, it would jamb when you want to trice the tack up, or lower the sail down.

As a rule spankers are not now laced round the mast, but are secured to hanks which travel on a T angle iron up and down the mast, the lower part only is laced round the mast.

106. PEAK HALYARDS.—The advantage of the standing part being secured to the topmast head, consists, in the counteracting pressure of the sail and weight of the gaff against the forward strain of the top-sail braces, which is not fully met by the mizen topmast backstays as they have so little drift; but, on the other hand, an additional strain is brought on the topmast stay, when the yards are swung in working ship.

107. LOWER-TACKS AND SHEETS.—Taper off towards the hauling end, for convenience in handling.

108. SHEETS OF FORE-AND-AFT SAILS.—Should lead in a line drawn direct from the centre of gravity through the clew.

The centre of gravity of a staysail is found by bisecting any two sides of the triangle, drawing a line from these points to the opposite angles of the sail, and marking the point of intersection.

Square sails are, first, divided into triangles; then the centre of gravity of each is found, as already shown; and the centre of gravity of the sail is where a perpendicular, drawn from the centre of either the head or foot, intersects a line joining the centres of the triangles.

The centre of gravity of a trysail or spanker is at the point of intersection of two lines—one of which joins the centre of gravity of two triangles, formed by a diagonal drawn from the peak to the tack—and the other joins the centres of two similar triangles, formed by a diagonal from the neck to the clew.

109. Quarter-blocks.—The sheet is rove through the after sheave ; for, on the *lower* sail being taken in, its clew-line would lead across the sheet, if rove through the foremost sheave. When cap clew-lines are used, the quarter block is single.

110. Top-tackle Fall.—The upper block should be the swivel-block, because the turns are taken in by the pendant.

111. Topsail Sheet.—Chain topsail sheets are invariably fitted now, they shackle on to the clew of the sail, then reeve through a cheek sheave at the yard arm, through 2 or 3 roller fair leads under the yard to the quarter, and from thence are fitted with a single whip to the deck.

112. Top-gallant and Royal sheets.—Are bent with an eye, which goes over the toggle in the clew of the sail.

The clew-line is often bent round the splice of the eye.

When at sea the clew-line should always be bent round the clew of the sail.

113. Fore and Main-sheets.—The hook lies with the point up ; for, when the sheet hangs in a bight, the hook is liable to cant out if pointed downwards.

114. Main Buntlines, leading aft.—Allow the hands to work round from the clewgarnets.

115. Blocks.—Reef-tackle and clew-line blocks are called *strop board* ; and fore tack, *shoulder blocks.*

116. Toggles.—Are distinguished as *round*, and *ducks-bill ;* the latter are also sometimes called *spring* toggles.

117. GAB-ROPE.—Rove through a block on the bowsprit cap, bent to a cringle in the foot of the jib, and placed so as to bring the foot of the sail taut along the boom; in bad weather it is the greatest possible assistance to the men engaged in stowing the sail, as it brings in the foot to them, and steadies it there while they gather up.

118. HIDING A ROPE.—When the nip of a rope always comes in one place, that part must become badly chafed before the rest is much worn; to remedy this, a strip of soaked hide is worked between each strand of the rope where the nip takes, as at the yard-arm for a top-gallant sheet, or at the thimble for a main bowline.

119. SPIDER HOOP.—Is a general name for any hoop round a mast, except the mast hoops,-such as those with belaying pins attached, or those for awning ridge ropes; but the proper spider hoop is the hoop on the topmast head, through which top-gallant rigging reeves.

120. REEF-PENDANTS OF BOOM MAINSAIL.—A matthew-walker is made in one end, and the pendant rove through a hole in the cheek on the side of the boom, with the knot underneath, then through the cringle in the sail, down through the sheave hole in the cheek on the other side of the boom; and a bowline knot, or a hitch with the end seized back, is made in the end, to which the tackle is hooked, and led along the boom.

121. TRIATIC STAY.—Is the name given to a schooner's mainstay when it sets up to the foremast-head, or, else, reeving through a strop abaft the mast-head sets up on deck.

When led straight on deck, two stays are required, the weather one being pulled up, and the lee one overhauled on going about.

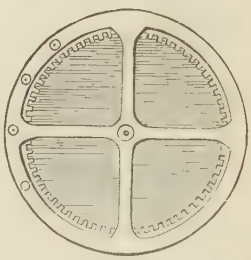
122. Largest Rope and strongest Rigging.—The fore top-gallant braces, when rove double, are the longest ropes, and the forestays, mainstays, and lower rigging are respectively the strongest pieces of rigging.

123. Largest Blocks.—Treble and four-fold 30-inch.

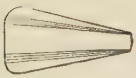
Chapter VI.

KNOTTING AND SPLICING, STRENGTH OF ROPE.

124. Use of the Ropemaker's Winch.—A ship's winch, which will make very fair 2-inch rope, is about 15 inches in diameter. In the frame, which is double, are placed five hooks—the three upper ones for general use, the fourth for four stranded rope, and the centre one for hardening up large rope after it has been laid up by the upper ones (the latter not being sufficiently strong for that purpose). The shanks of the hooks, between the two parts of the frame, are inserted in cogged barrels, which are turned by the wheel, one revolution of which gives nine to the hooks—any one of which can be thrown out of gear by hauling it back close to the after part of the frame.



A *loper* is a swivel-hook which by revolving freely, allows the strands to twine up together, by the twist put in them as the top is withdrawn.



The *top* is a conical piece of wood, scored on the outside for the reception of the strands. Its use is to keep the strands separate between it and the winch, and to regulate the amount of twist in the rope behind it, by being moved along either slowly or rapidly. When four-stranded rope is required, a hole is bored through the centre, as a lead for the heart.

A length of junk being brought on deck, you proceed to unlay it by attaching the strands to separate hooks, and the loper to the other end—one hand holding back on it, and then heaving back—two hands following the rope down to separate the ends.

Spun-yarn is made by hooking all the yarns that compose it (according to the size required), upon one hook. You then heave round, the reverse way to the lay of the yarns (which in ordinary rope are all right-handed) until there is plenty of back turn in them, holding on the ends by hand; then rub down, and make it up.

In rubbing down, a boy puts the end of a strand over his shoulder, and walks away with it, another hand holding on the rubber (which is the end of the strand doubled up loose) round the stuff they are laying up.

As many lengths of spun-yarn can, of course, be made at once as there are hooks on the winch.

Nettle-stuff.—Hitch the yarns to separate hooks; let a couple of hands then take hold of them, and commencing close to the winch, walk back while it is hove round the

reverse way ; the yarns are thus hove up the contrary way to what they were originally, to soften them ; for, when drawn out of rope, they are usually hard and angular, and would not lie square, or bear an equal strain, if laid up in that condition.

When thus relaid, the ends are knotted together, the loper hooked on—one hand holding on to it, the top put in, the winch hove round the same way as at first, and the top moved along towards the winch. When up to it the top is taken out, the yarns unhooked, and hitched to a single hook, than the winch hove round the opposite way to what you have just been heaving it, to harden the stuff up, rubbed down, and made up.

Thus, the yarns will be left-handed, and the nettle-stuff right-handed ; for though the winch is hove round the same way with both, the twist in the yarns causes them to untie abaft the top with the lay of the contrary denomination, and the revolutions of the loper prevents the turn coming out again.

Six (or nine) thread stuff.—Put two (or three) yarns on three separate hooks ; hold on the ends by hand, keeping each of the three lengths separate, and heave round a reverse turn, as with spun yarn. When sufficiently hove up, knot the ends together, hook on the loper, put in the top, and proceed as with nettle-stuff.

Cable Nippers are laid up the same way.

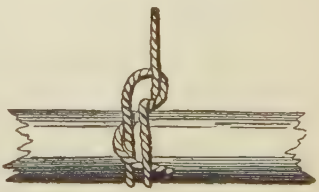
Hammock-lashings are made of three strands of three or four-yarn nettle-stuff, hove round the reverse way, which forms cable laid stuff, left-handed.

125. KNOTTING AND SPLICING.—The important items of practical seamanship here enumerated can only be properly taught by practical demonstration, and I therefore, in this instance, feel disposed to vacate in favour of the boatswain, and to recommend my "young gentlemen," readers to ply their marling-spikes assiduously on those Saturday afternoons so considerately set apart in most ships for that purpose. However, for the benefit of those who cannot, perhaps, avail themselves of the boatswain's assistance, I subjoin a description of all that is of any practical use, omitting that which is either merely fanciful or obsolete.

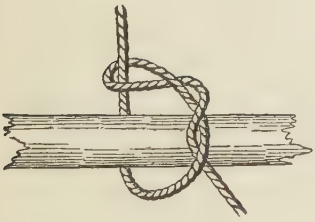
126. SHEET-BEND.

127. CARRICK-BEND.

128. STUDDING-SAIL BEND.—Two round turns round the yard; then half-hitch round the standing part and under both parts, and the end tucked in between them.

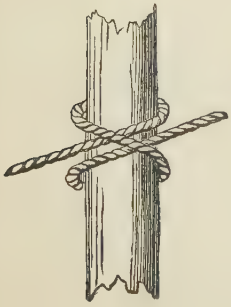


129. Rolling Hitch.—A rolling hitch is that used for stoppering a rope. It is formed by taking a hitch with the stopper round the rope, then taking another hitch above the first and between the stopper and the rope, and then dogging the tail *back* round the rope *with the lay*.



130. Timber Hitch.

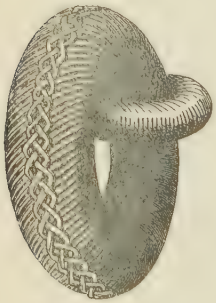
131. Blackwall Hitch.



132. Clove Hitch.

133. A RING-BOLT is usually hitched over with either two or three ends. With two ends,—after seizing or hitching the ends you are not working on, to the ring bolt, you commence by taking a left-handed hitch with one of the tails, keeping the cross on the centre of the bolt, which brings the end out to the right: you then double this end back over its own part to the left, bring up the other tail over this, take a hitch as with the first, double it back, bring up the first end, and so go on, taking alternate hitches with each, and bringing the end out to the right with each hitch.

With three ends,—you begin by taking a left-handed hitch with the first leg, a right-handed hitch with the second, then left-handed with third, right-handed with first, left, second,— right, third,—and so on, each hitch being passed in the opposite way to the preceding one—two ends and one end alternately lying on each side. The ends are finished off by scraping them down, and either passing a whipping, or working a Turk's head round them. When completed, it has the appearance shown in the cut.



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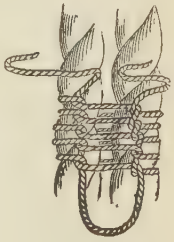
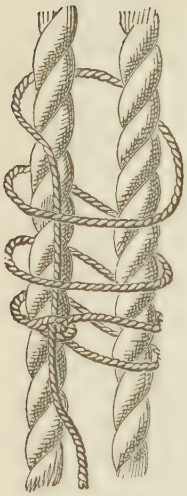
134. A COMMON MARLING HITCH. Is that used for lashing a hammock up, and is simply thus :—

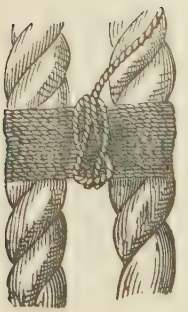
A Marling Hitch for davit-head blocks (fish), &c., is formed by middling the marline, laying the bight along the top. in the centre and securing it there ; then dipping the right hand end underneath and taking a turn under, and round the left ; bringing the left up, and taking a hitch over, and through the bight of the right-hand end ; heaving the turns on taut, and keeping them square.



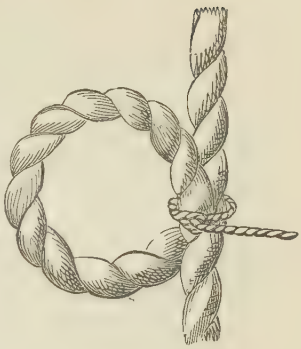
135. KECKLING A HAWSER—Serving it over with rope and thus keeping it from being chafed.

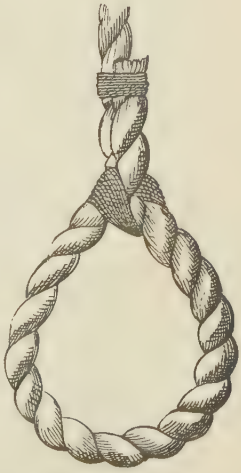


136 Round Seizing.—Splice an eye in the seizing, pass it under both parts of the rope, and reeve the end through the eye; slack up, lay hold of the upper turn and end part with your left hand, and under turn with your right, and work the seizing round left-handed until enough turns, six, eight or ten—are wound round; then reeve the end back between the upper and under turns, and bring it up through the eye; then heave each turn taut separately, keeping the eye on the left hand side. When you have hauled the end taut through the eye, pass the riding turns round, in the same direction as at first, one in number less than the inner turns and hauled hand-taut. When all on, pass the end down between the two last parts of the upper side of the inner turns, between both parts of the rope, and pass two round turns, crossing all parts of the seizing; then slue the rope over, and finish off with a reef-knot on the under side, as in the figure.

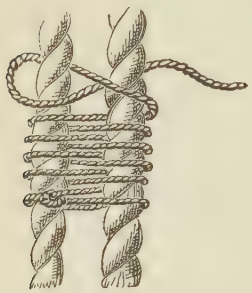


137. THROAT SEIZING.—The old throat seizing, used when rigging was turned in with end up, is now seldom required except in seizing a thimble into one of the smaller stays. The end of the rope being laid over the standing part, the seizing is passed, precisely as a round seizing, until you have passed the end down between the two last parts of the inner turns, when, instead of passing the crossing turns right round, you reeve the end between the upper and under turns of the seizing, bringing it out alongside the eye, and so only pass the crossing turns over the upper half, finishing off with the reef-knot on the top of the seizing. Then, when the end of the rope is seized up to the standing part, it will be seen from the tautness of the underneath parts of the seizing, occasioned by the end and standing part of the rope being brought together, that the tension on the crossing turns would be too great if they were passed round all.





138. Racking Seizing.—The first turn is passed round both parts of the rope like a round seizing; it is then dipped between both parts, and the remaining turns are passed as racking turns—over and under, When the requisite number are on, reeve the end down inside the last turn, bring it up outside and pass the outside turns back towards the eye of the seizing, allowing them to sink in between the parts of the first turns; by which it assume the appearance of a flat seizing, as there are in reality no *riding* turns. When down to the eye, dip the end down between the two first turns, and finish off with a reef-knot.



139.—A Flat Seizing.—Is commenced the same as a round seizing, but on the end being rove through the eye, it is finished off at once with a reef-knot without any riding turns.

140. Shroud Knot.—Open out the ends of the rope that are to be knotted, put them together as for splicing, and single wall the strands of each end round the main part of the opposite end; then taper the strands off, marl down, and serve over.

141. Single Wall.

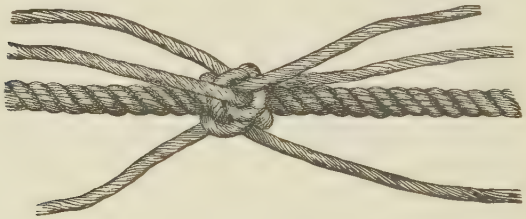
142. Wall and Crown.

You may now double wall and double crown, by letting the strands follow their own parts round; first double walling and then double crowning, and cutting the ends off.

143 Double Wall and Double Crown.

144. French Shroud Knot.—Crown backwards, left-handed, the strands of each end; then dip the ends that

lie *from* you to the left of those that fall down *towards* you, haul them into their places, and you will find that they will accommodate themselves to the knot better in this way, than if they were allowed to remain as they came out. The knot will then appear thus :—



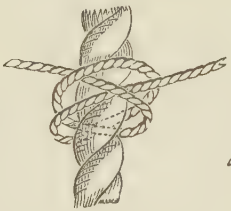
Then tuck the ends as in splicing (which you can do, also with the common shroud knot), or tease the strands out and marl down.

145. MATTHEW WALKER.—Put a whipping on (as with all knots), open the strands down to the whipping, and

pass the first end through its own bight, the next through its own and the first and the third through all three bights ; haul the ends through, work the turns round and place them ;

and the knot will appear as in left-hand figure.

146. Turk's Head.—Take two round turns round the rope, pass the upper bight down through the lower, and reeve the upper end down through it ; then pass the bight up again, and reeve the end over the lower bight and up between it and the upper one ; dip the upper down through



the lower bight again, reeve the end down over what is now the upper bight, and between it and the lower ; and so proceed,—working round to your right until you meet the other end, when you pass through the same bight, and follow

the other end round and round until you have completed a plait of two, three, or more lays, as you wish. The right-handcut shows a Turk's head of two lays.

147. Turk's Head worked into a Rope.—This is done when the knot has to resist a strain, as the rung of a Jacob's ladder. You middle the marline or nettle-stuff that you are working with, and splice a second piece into the centre so as to form a third leg ; then pass an end through the rope, and haul it through to the junction of

the third leg which reeve through the third strand of the rope, bringing an end out between each strand.

Then crown the ends round the rope, left-handed; slue round, and crown them back, right-handed, and the knot will appear as in the figure. Follow each part round with its own end, cut the ends off, and it will be undistinguishable from the common Turk's head. With four-stranded rope, you use four ends.

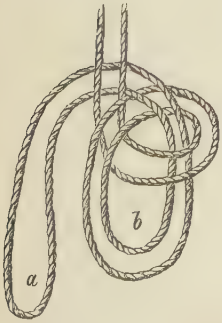
148. Reef Knot.

149. Stopper Knot.—Double wall, lay the ends up, put a whipping on, and cut them off.

150. Bowline Knot.

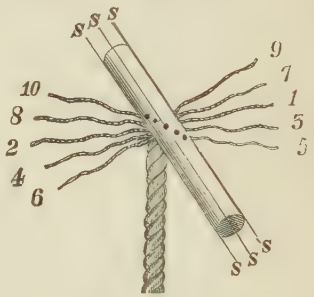
151. Running Bowline.

152. Bowline on a Bight.—The bight *a* being passed over *b*, forms the knot *c*.



153. Flemish Eye.—Put a whipping round the rope, open the strands out down to it, leave out the outside

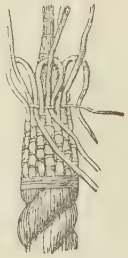
yarns and stop them back, and make the rest up into foxes. Halve them and put a round piece of wood the size of the eye required, between them on the top, with three stops laid along it, *S*, *S*, *S*. Knot the centre foxes of each side, 1 and 2, on *the top* of the spar, and knot 3 and 8 from you, with a knot a little round to the left. Then when all on that side of the centre fox are expended, commence on the other side, and knot 7 and 4 a little round to the right, towards you, and 9 and 10 more round and so on. When all are knotted, tie the stops together, to keep the eye from falling adrift, and take the spar out ; put a seizing round the foxes close to the shoulder of the eye, and then cut them off. Bring the outside yarns over from each side, placing them in the hollows to round the eye off ; tease the ends out, and worm them in between the strands at the shoulder. Then marl all down, fid the eye out, parcel, and spike-serve it. When neatness is an object, graft he eye over with nettles made of two outside yarns.



154. A Fox—is made by rolling a couple of yarns up the contrary way on your knee, and then rubbing them down.

A Spanish Fox.—is a single yarn rolled up the reverse way, and rubbed down.

155. Pointing a Rope.—Put a whipping on, open out the strands down to it, and form the heart of the inside yarns, tapered off, and marled down hard. Having left out the outside yarns, and laid them up into two-yarn nettles if the rope is not very small, tell them off, one up and one down alternately; knot the filling with a timber-hitch over the upper ones, pass two turns, and dip the end between both to jamb it before hauling the last turn taut; then bring the upper nettles down, and lay the lower ones up, pass the filling, and so proceed, hauling the nettles taut up after each round, and passing the first turn of the fillings under one or two of the upper ends in advance, each time, instead of over them; which allows the lower nettles to hide the hitch when brought up. To finish off, secure the lower nettles with the filling, as shown in the figure. Cut the upper ones off as they are, and the lower ones when you have passed two turns of the filling, hitched it and hauled the bight of the nettles close down.



With large ropes, you secure the upper nettles as well by taking a hitch with the lower ones round the upper ones and the filling thus :—

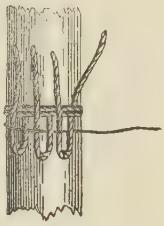
Grafting,—in which the rope or strop is covered the entire length, and not at the end only, as in pointing, is performed in exactly the same manner, with nettles laid along it.

156. Pointing a large Hawser.—Clap on a whipping of three-yarn nettle-stuff, snaked. Open out the strands lay the heart up three-stranded, and splice a becket into it, which has previously been eye-spliced into its own part. Lay the outside yarns up into five yarn sennit : use, for filling, a two-yarn fox ; and continue as already shown.

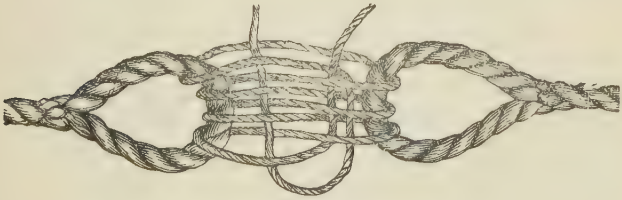
157. Cross pointing.—Commence as for straight pointing and, having laid the nettles, one up and one down alternately, bring an upper nettle down to the *right* of its corresponding lower one, lay the lower one up, and work in this way once round to the right ; commence again, and bring what are now the upper ones down to the *left* of the lower nettles, lay the lower ones up, and so work round backwards ; then, bring them down again to the right and so go on. Finish off with two turns of straight pointing, as in right-hand fig.

158. Hitching—Is a very convenient method for covering boats' awning stanchions, &c., and doubtless, many of my readers, when attached to landing parties, have availed themselves of serviceable looking soda-water bottles, slung and protected in the same manner. The nettles to be used are middled, laid along the article to be covered, and secured in their places with a turn of filling. If working from one end, as in the cut, all the nettles are taken up : if working from the centre towards the ends, the nettles on

each side of the filling supply their own end. The turn of filling being passed and hitched as in pointing, commence hitching the nettles round the filling, hauling each taut separately, working to the left, keeping the filling taut, and going round and round. If what you are covering contracts in circumference, you must leave out a nettle occasionally, and cut it off; and, should it increase, lay fresh ones in. It is finished off by keeping the bights of the last round slack until you have passed a couple of turns of the filling and hitched it, as in finishing off pointing when in the same manner, haul the bights close down, and cut the ends off.



159. ROSE LASHING.—Reeve through the eyes to be lashed, middle it, and pass the racking turns, leaving off with the ends in the same bights; pass each end between the bights of the lashing on either side of the crossing, as shown



in the cut. Then take two or three round turns, passing them opposite ways, haul them well taut, and knot the ends.

160. A NETTLE.—Is made of two or three yarns, laid up with finger and thumb, keeping the lay in the yarn, and is left-handed stuff.

Thumb Line.—Is made of yarn twisted up the reverse way, and is right-handed.

161. Whipping a Rope.—In the ordinary manner, is done by laying the end in the lay of the rope, pointing up towards the end, passing a few turns round the rope, binding the end of the whipping; then laying the other end on the turns already passed, pointing downwards, passing the remainder on the bight, round the rope and the last end part, hauling through on the end part, and cutting off.

A West-country Whipping.—Is that used for putting a mark on the fore brace, for instance; and is done by middling the whipping, and half-knotting the ends on each turn, on opposite sides of the rope; and finishes by knotting the last turn with a reef-knot.

A Sailmaker's Whipping.—Is put on with needle and twine. A reef-point has always two such whippings on the end. It is first stuck through with the needle, the twine is drawn to the end, several round turns are passed, the reef-point is stuck through at each end of the whipping, and two crossing turns are passed; then secured with two half-hitches round the upper part of the crossing turns, and hauled close down.

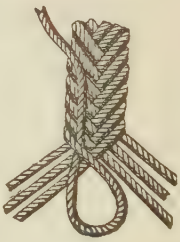
Crowning the end of a Rope.—Is a rough substitute for whipping; and the strands are then tucked in twice or thrice, as in splicing. Lead lines are generally served in this way.

162. A GRUMMET.—Take a strand, three times the round of the grummet required, with end enough in addition for tucking in, for finishing; middle it, lay the right-hand end over the left, and follow the lay round with each end until the rope is re-formed then tuck the ends in where they meet as in splicing.

163. A SELVAGEE STROP—Is made of spun-yarn, or small rope, according to the size required, warped off, and marled down.

164. COMMON SENNIT—Is made with an odd number of nettles If, however, an eye is to be formed, you commence with an even number—one being a short one; and after the eye is formed, the short end is worked in, or, if too long, left out and cut off,—leaving an odd number to go on with. We will suppose that a reef-point is to be made of seven parts of spun-yarn :—Cut off four lengths (one being but little more than half the length of the others), middle them, toggle the bights through a becket triced up before you, halve the nettles, lay the right-hand nettle over the next one to it, bringing it over to the left, making three now on your left, and one on your right; bring the outside nettle on the left over two, which will equalize them again; then the right over one, left over two, and so on alternately till you have worked length enough for the eye; next bring all eight parts together

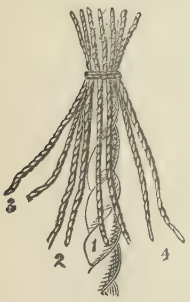
halve them and go on as at first—right over three, and left over four. When two or three lays are worked in this way, leave out the short end, and continue with seven parts,—right over three, and left over three in succession. Finish off by forming a bight of the left hand nettle when you bring it over, laying the end up; and as you work the remaining nettles in, point them down through this bight; and, when all are in, secure them in their places by hauling the bight taut through upon them and cutting the ends off, as in the left-hand fig.

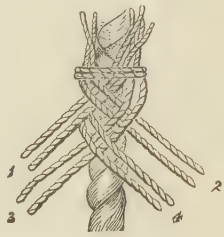


165. FRENCH SENNIT.—Like common sennit is made with an odd number of nettles. If about to make a harbour gasket for a royal yard in this manner, of nine parts of nettle-stuff, cut off five lengths (one being a short one), middle them, put a seizing round the bights to form the eye, which marl down, and serve over; then bring all nine parts together (having left out the short one after the seizing was passed), and divide them with five to the right, and four to the left; weave the outside one on the right, over and under the nettles on its own side, bringing it out to the left, then do the same, with the outside nettle on the left, and lay it out to the right, when there

will be again five on the right, and four on the left, and so continue the mat in the same manner.

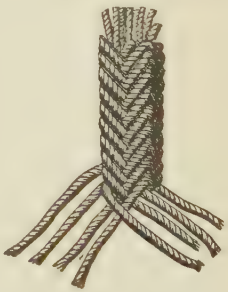
166. ROUND SENNIT—Is used for man-ropes, yoke-lines, &c. Stretch a heart of small rope taut along between two belaying pins, or other convenient fixture ; take 8 (12, 16, or more) nettles, put the whipping round the heart and ends, to hold them, divide them into fours of 2 (3, 4, or more (parts each ; then lay No. 1 pair over the heart, to your left ; then No. 2 to your right, crossing the 1st pair ; next No. 3 pair under all to the right, and over No. 2 ; No. 4 round under all to the left and over No. 3. Then No. 1 round to the right, under 2, and over 4, 2 round to the left, under 3, and over 1 ; and so on, always bringing the upper pair on the opposite side, to cross over the pair last passed. Finish the end off by pointing the heart with the nettles made into smaller ones ; and finish the top by walling and crowning the heart, covering it with duck to round it, then double-walling and crowning the nettles over the heart knot, previously whipped underneath, with a Turk's head to cover the whipping. Or, after forming the knot of the heart, and covering it, and putting the whipping round the nettles underneath, you may cut them off, and cover the knot with Turk's heading of mackerel line, begun very slack



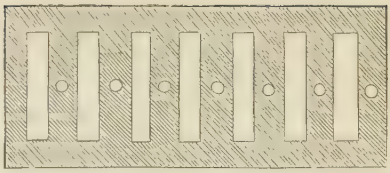


and spread over the knot, by passing with a sail needle, as many lays in the plat as will be required to cover the knot.

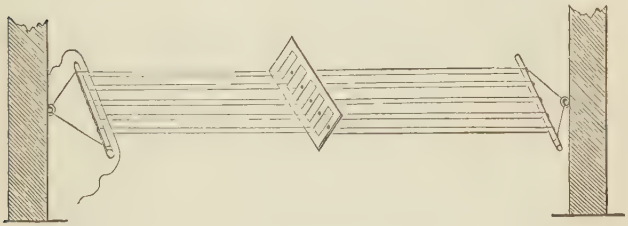
167. SQUARE SENNIT—Is used for the same purposes as round sennit, and also by engineers, as packing for their pistons. It is made somewhat in the same manner as round sennit but without a heart. Nettles are used in the same ratio, increasing by fours, but are worked singly instead of in pairs. Having put a whipping round the (eight) ends, divide the nettles, and lay half on each side; bring the uppermost left-hand nettle round underneath all, and up inside two of the right-hand ones—crossing over the latter ones to the left, and making four on each side again; then take the uppermost of the right-hand nettles, pass it under neath, and under two and over two of the left-hand ones—still keeping four on a side, because the nettle taken up always comes round to its own side again. To proceed, take the upper nettle on each side alternately, and finish off as you finish round sennit.



168. SWORD MAT.—At a distance apart, equal to the length of the mat, sling a couple of bars in a horizontal position. Hitch one end of the warp to the bar at the end on which you intend to terminate the mat; take up the loom, which is made of a sheet of copper perforated with holes and slits alternately, reeve the other end through the first

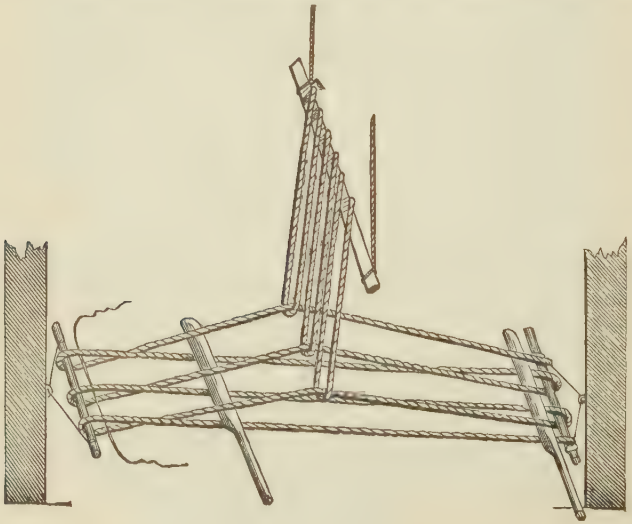


hole, over and under the bar at which you intend to begin, back through the first slit, under and over the other bar; and so wind off as many parts as are required for the breadth of the mat, the last turn being rove through a slit, and secured to the bar, at which you finish off. This done, lift the loom up, middle the filling, and lay it between the upper and under parts; then lower the loom, and the parts that were lowermost will rise in the slits, become the



uppermost, and thus put a cross in the warp. Next put the sword, made of hard wood in the shape of a knife, in between the upper and under parts, and drive the crossing close up towards the bar, and harden it well up; then pass a turn of filling to secure the crossing, reeving the ends through contrary ways, haul it taut, take out the sword, lift the loom up, and go on again. When you come to the last turn of filling, half knot it with two turns.

If you have to make a mat for which your loom is not large enough, you rig a fiddle, by slinging a handspike athwartships to the main deck beams overhead; pick up every other part of the warp, and, with a piece of nettle-stuff passed over the handspike with *two round turns*, and rove round the alternate parts of the mat, trice them up. The upper parts will thus cross the under parts before and abaft the fiddle, and you will require two swords. Reeve the filling, and secure the first crossing already formed, by the parts being triced up, in the ordinary manner, hardening it up with the first sword; now, put the second sword in between the crossing and the bar abaft the fiddle, give the mat a shake to disengage the parts, and with the sword lift the upper ones up; the crossing will thus be extended before the fiddle, so withdraw the first sword, put it in



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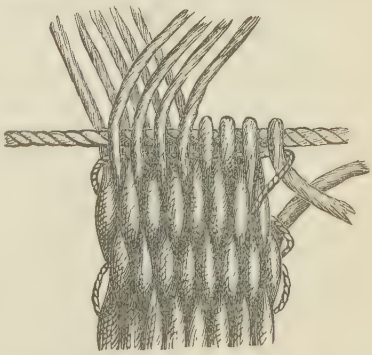
abaft this crossing, drive it up and secure it with a turn of filling; again lift up the fiddle, keeping the second sword fast (which is never removed); a crossing is again formed at each end; and you again repeat the operation.

With a heavy boom-mat five or six feet wide, you require a second fiddle underneath, to rouse the parts through. A couple of hands jump down on the hand spike; and the upper one, which is triced up by a couple of jiggers, is lowered at the same time.

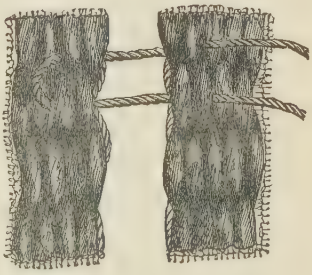
To finish off or *selvage* the mat:—After passing the last turn of filling, and securing it with a half-hitch with two turns, you lay the lanyard across on the top of the filling, and commence unreeving again the front row of nettles, one at a time, beginning on the right. As you withdraw them you bring the corresponding nettle, at the back, over the lanyard, and filling, and reeve it back through the hole left vacant by the one hauled out, thus: go right across, and haul the bights taut down to the lanyard. On slueing the mat round you will find that this will leave the second row of filling bare; so go on withdrawing the same ends again along the second row, and pointing the same reeving ends



as at first, through the holes the others came out of, covering the filling and complete four or five rows of this in the same manner. Then, to cover the last row of filling, and to secure the ends of the nettles, you lay them up and down alternately, the long ends that you have withdrawn going up, and the short ones that you have been reeving, laying down; haul them taut, beat them in, and then tuck them under the bights of the next lay, the lower ones left-handed through the bights to the right, and the upper left-handed to the left. Beat the mat down and cut the ends off.

To finish off by *shouldering* as for the upper part of a lower rigging mat (when, after reaching the top of the dead-eye it is contracted in order to cover the shroud for a few inches), you leave as many nettles out at each edge of the mat as will reduce it sufficiently, then lay the lanyard (to secure the mat above the dead-eye) along the top of the last turn of filling, and go on working on the centre nettles that you have retained, as far up as you intend to go. Knot the filling, tease the ends of the nettles out a bit, place them round the shroud and serve them over. The ends that you left out, on each side, you finish off by selvaging, as already explained. As the rigging stretches, turn the bottom of the mat up, with the end inside.

169. Splicing a Sword Mat.—Unlay six or eight inches of each mat, open the ends out, marry them together, laying one up and one down flat along the mat, withdraw the nettles on one side of one (No. 1) mat, and point the nettles of the other mat (No. 2 through the holes they come out of; all ends will then disappear from that side, and there will be four rows of ends on the other. Slue over, pick out the proper nettles of the side, which have been married together, withdraw the ends belonging to No. 2 mat, and introduce the corresponding ends of No. 1 through the holes. The same operation has now been performed on each mat, and on each side there are now two rows of ends; marry those together on each side, laying one up and one down, and go on splicing by withdrawing and reeving, for two or three rows more in each mat. Leave off with the ends all out on the same side, and finish off as with selvaging.

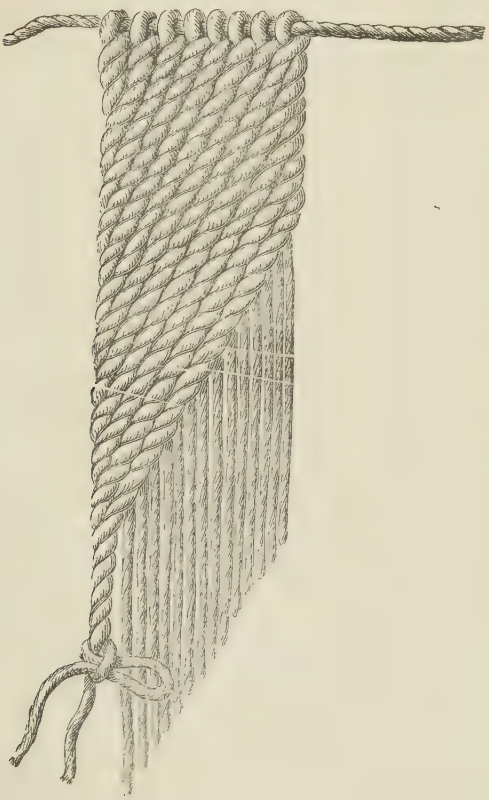


A Cobbler's Stitch—Is used for joining the sides of mats together. Take a filling of roping twine, middle it, and reeve each end through two bights in each mat, (if a heavy mat, through three bights at each edge), then reeve the lowermost end back through the same bights as the upper end, which will bring the ends out at opposite sides; draw the mats together, and reeve both ends through two turns in each mat again, passing each other

through the same hole opposite ways ; and so work on like a cobbler stitching a sole. Finish off each end, by taking a hitch through a bight in the mat of the next lay above, and cut the ends off.

170. PAUNCH MAT.—For heavy rigging mats, strands of 3-in. or $3\frac{1}{2}$-in. rounding would be used for foxes, with a lanyard of $2\frac{1}{2}$-in. Stretch the lanyard along at a convenient working height, middle the foxes and lay them across it, and, commencing on the left, lay up one turn in the first pair, right-handed. Repeat this with the second pair, and lay up the nettle that comes round to the front and left, one turn with the underneath nettle of the first pair, which was brought out to the right ; then lay this latter up, one turn with the other nettle of its own pair, and take a hitch with it,—which do with the two last nettles on the left, each time that you work down to them, to keep the mat from unlaying again. Now commence with the third pair.—take the underneath nettle round the upper one, which lay up with the underneath and right-hand nettle of the second pair, which lay up with the other one of the second pair, which lay up with the under one of the first pair, which lay up with the left-hand nettle of all, which lay up with two or three turns to prevent unlaying, round which take a hitch So proceed until all the nettles are brought in,—a second hand holding them back as you lay up, and when you have come to the last, and the full breadth of the mat is formed, go on in the same way, working down for length. When you have obtained this on the left edge of the mat, it will appear as in the figure ; and you then begin to work down

square, taking a hitch with each pair as you have finished with then, to prevent them unlaying.



To selvage it, take it down, and lay it on a grating; commence with the first left-hand fox which bring round under the next one, and lay up along the mat, laying the

one that it comes round (which is the second fox) downwards, and in this manner go right across; then stretch the lanyard along the nettles where they cross, and hitch the ends to the grating. With the first fox laid upwards take a right-handed hitch round the lanyard and the first one down, then take the down one, *a*, dip it back under the lanyard and haul it taut down, another hand at the same time hauling back on the upper one and so knot the foxes right across. When done, haul all the lower ends taut up, and, beginning on the left, cross the upper nettle (which is on the left of the lower) over it, and reeve it through the bight in the mat in the immediate lay to the right, bringing the end out to the left: (rove left-handed). Beat the hitches down, and cut the ends off, but not close; for if left of the proper length, they will form two rows of thrums. Tuck a thrum in every third bight up, and in every other lay across, which is quite thick enough; and beat down the bights in the mat that they are rove through, each time separately.

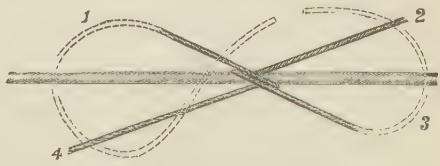
To make a Breeches Mat — Mats of this shape are used for the collars of stays; the broad part lying over the crutch, and the legs lacing round each fork. You work the mat down square as far as you require it, then halve the foxes, and work each part down separately for the legs.

You may convert an ordinary mat into a breeches mat by cutting the midship fox across at the head, and simply

unreeving it down as far as is wanted; then crossing the ends, and tucking them into adjoining bights.

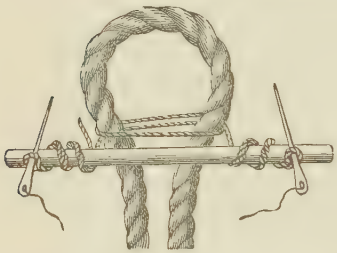
To repair a Rigging Mat.—That has had a hole chafed through it. Stick sufficient foxes through the bights of the mat at the top of the hole, to cover it, lying well over the edges, and back clear of the hole, and middle them. Bring the left-hand fox round the next one to it, lay its end up, and the one it comes round downwards, like the commencement of selvaging; go right across and secure it by sticking the left-hand nettle, right-handed, through a bight in the mat in the edge of the hole, and the right-hand nettle, left-handed, through a similar bight, the ends of each pointing outwards; then work the next and succeeding rows as a paunch mat is worked, but working square across, laying one fox up with its next only, and securing each row as it is completed, by tucking the right, and left-hand nettles in as you did with the first row. When you have thus covered the hole, stick all the ends through the bights below them left-handed once or twice, and cut them off; then slue the mat over, and either stick the broken ends into the new piece, or bring the edges together with a lacing.

171.—Drawing and Knotting Yarns.—Having taken the twist out of the strand, let a couple of hands lay hold of the ends, and beat it on the deck to loosen the yarns, which are then drawn out. They are knotted together, for rope-making purposes, by splitting



the ends, scraping them down, and marrying the forks together. No. 1 end is then brought underneath towards you and half-knotted to No. 3 end, which is passed underneath, from you, giving it somewhat the appearance of a reef knot; then tauten it to jamb the knot, and cut the ends off.

172.—A Spanish Windlass—Is used for heaving two parts of a shroud together at the nip, before passing the seizing; and for many other similar purposes. A strand is laid on the top; the ends are crossed underneath, and brought up on opposite sides, the bights taken round a bar, or lever, laid on the top, a twist is taken in them, and a marlinspike is inserted In the bights at each end, and hove round upon.



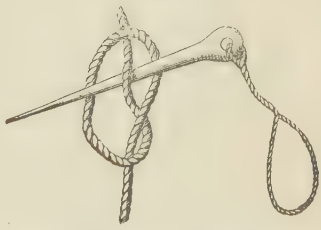
173. Worm, Parcel and Serve.—A rope is wormed in order to give it a round snug appearance; the ends of the worming are seized round the rope, or tucked in, and then wound along the lay. After being passed by hand, worming is hove on by a soft strand knotted and taken round the rope; a bolt is then passed through the bights and the strop twisted up and hove round the rope, which tautens the worming as it proceeds. With very large rope, the worming requires backing on each side with smaller stuff. in order to fill it up properly. If the rope is not to be served, a seizing, snaked, should be put round the worming at intervals, to keep it in its place, as it is liable to work slack.

Parcelling, which is employed to preserve the rope from wet, is made of tarred canvas, and is passed with the lay of the ropes, with the edges overlapping.

Service is used to protect the rope from chafe, and is passed against the lay of the rope. It is commenced by passing the first turns over the end, and finished by slacking up the last three or four turns, dipping the end through them, hauling them taut singly, and then drawing the end through.

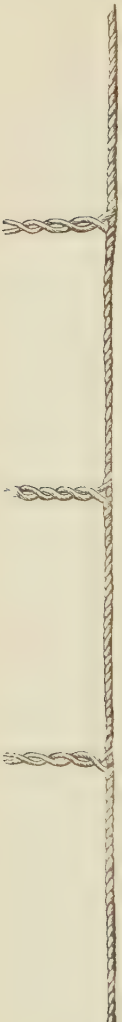
Spike-serving.—Is used when you have a small eye or similar piece of gear to serve. The turns are passed by hand ; and each is hove taut separately by taking a marlinspike hitch over a marlinspike, and with the point prizing it against the rope until the service is taut.

174. A MARLINSPIKE HITCH.—Is used for heaving the turns of a seizing taut* for steadying the point of the marlinspike when going aloft, &c., &c. The marlinspike is laid over the lanyard, the part that is towards you laid over the other part, crossing the marlinspike, the bight thus formed doubled over the marlinspike withdrawn and stuck in between the midship part and the bights, in which position it will resist any strain ; and, directly it is drawn out, allows the knot to fall adrift again.



175. SHORT SPLICE.—Unlay the ends, marry them together, lay the strands of one end over the strands of the other end that are to the left of them, and under the next strand to the one passed over. Slue the rope round, and do

*It is preferable to use a mallet for heaving the horns of a seizing taut.



the same with the other strands; then put the strands on both sides, over one, and through the next again, or else put them in "once and a half"—(they have already been put through once, so you, in that case, halve the strands, put the upper half through, and leave the under half out, which hides it;) then stretch the rope, and cut the ends off.

176. Long Splice.—Unlay the ends alike, but for a much longer distance than for a short splice, and marry them together; unlay a strand on each side, and lay the strand of the other end, that is opposite to it, up in the lay that it comes out of, making both equidistant from the centre pair of strands, which you do not touch.

Twist each pair up as you have done with them, to keep them in their places, and cut off the spare ends; grease the strands, *whole-knot* them together, stick them in once and a-half, and cut the ends off. For a large rope, such as the fore brace, instead of knotting the strands, merely lay them alongside each other in the score of the rope, then put the ends in once, a half, and a quarter, and *back it* with the remaining quarter of a strand to taper it off. In splicing, instead of laying

a strand over one, and under the next, you *back it* by putting the strand in, left-handed, under the strand you would otherwise have laid it over; which gives it an exceedingly neat and serviceable finish.

177. Eye Splice.—Unlay the end, and lay the strands on the rope the required length of the eye down from the bend; stick the midship strand under the strand of the rope on which it lies; lay the next end over this last strand, and under the next one; slue the eye over and stick the third end in under the third strand, put the ends, or half the ends, in again, and cut them off.

178. Cut Splice.—Unlay the ends, place them alongside each other in opposite directions, the one overlapping

the other equal to the length of the eye required. Splice the strands of each end in, as for an eye splice, and serve them over.

179. Horse-shoe Splice is formed like a cut splice, but differs in shape, one leg being longer than the other.

180. Grecian Splice.—Say that the rope to be spliced is a $7\frac{1}{2}$ inch topmast backstay. Put a whipping on, unlay the ends, lay the four strands up into ten yarn foxes, short-splice the hearts together, and serve them hard over with yarn. Then marry the foxes; and pass the ends that lie upwards over the next downward one of the right and under the bight of the second downward one, working round to the right. Haul all parts taut, scrape the ends down, marl over hard, parcel well with tarred canvas and serve. This splice is particularly neat; and, as there are no bends in it, it is necessarily much stronger than a shroud knot.

181. A deep-sea Lead-line.—Should be laid up, one end with the other, for three or four inches before splicing; for being hard stuff, it is liable to draw.

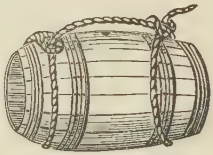
The marks should be tucked under a strand, after each knot is put in, and then they will lie flat along the line, and run no risk of fagging out, or being torn off, which they are subject to if the marks hang loose.

182. Cat's Paw.—Lay the bight of the rope over the end and standing part, as in left-hand figure; then, with a bight in each hand, take three or four turns in them by twisting them from you; bring the bights together and hook on.

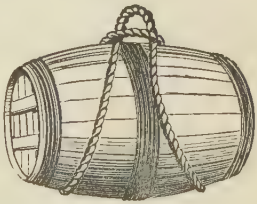
183. SHEEP-SHANK.—By laying the bight of the rope up

alongside the standing part, shorten it up as much as you require ; and then take a hitch with the standing part and end round the bights.

184. SLINGING A CASK—With butt slings. Reeve the end through the eye in the slings, slip the bight over one end of the cask, pass the slings round the other end, and take two half-hitches round its own part.



With Bale Slings.—Lay the slings on the deck, roll the cask over them, lift the bights up and pass one through the other, spreading them out well, and beating down as you get the weight of the cask.

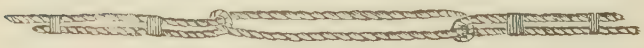


With a Ropes-end.—Make a bowline knot in the yard-whip, and stick the end back so as to form a short bight, to which bend the stay whip. Turn the bight of the bowline over its own part and slip each bight thus formed over one end of the cask.

With the head knocked in.—Slip the bight of the whip under the cask, take a hitch with each part over the head, and knot them together above.

185. To sling a Man—In the most secure manner: make a bowline on a bight, shorten one of the bights up, seat him in the long bight, and put his arms through the short one.

186. Bending two Hawsers together.—A *reeving*



(line) *bend* is about the best, with the ends seized back ; or

instead of that, a half-hitch through the bight of each hawser is frequently used. If the bights are bowline knotted, instead of being hitched and seized, the end should be thrust back between the standing part and upper bight, to prevent it jambing, in the same way that a toggle is often used with this knot ; but with a heavy strain a bowline-knot often capsizes. If in a hurry, a carrick-bend may be used for small warps.

187. Bending a Hawser to the Ring of an Anchor. —A fishermen's bend, which is the same as a studding-sail bend without the end tucked back, is what is generally used, but it becomes hard jambed with a strain. A *round turn*, a half-hitch, and the end stopped up, is far preferable ; and I may here remark, with reference to all purposes in which they can be used, that *two half-hitches will never either slip or jamb.*

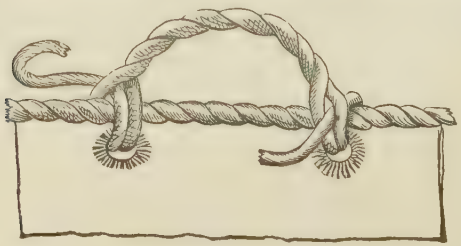
188. Reeving the Turn of a Seizing through a Small Eye.—After reeving a turn of the seizing, splice the end you are working on into the bight ; or, if you have already rove several turns, splice it into the bight last passed, then work all parts round and round until sufficient turns are completed, draw the splice and secure the seizing.

189. Working a Cringle in a Rope.—Unlay a single strand from a rope of the size that the cringle is required to be; begin on the left, and put this strand under two strands of the rope you are working it on; divide it into thirds and haul two-thirds of it through, so that the long leg is from you; lay the two parts up together so as to form sufficient for the round of the cringle, but always with an odd number of turns, ending with the long leg towards you; stick it from you

under two strands; bring it round and work back to the left; put it under two strands towards you, leaving one strand intervening between the place you entered it, then back over one, and down under two. Now tuck the short end in under

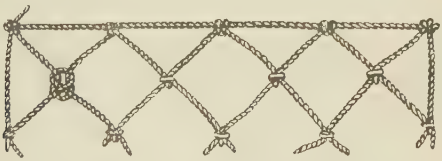
the same two strands in the rope as the cringle is already worked through, then over one, and under two; cut the ends off, and serve the cringle over.

If a cringle is to be worked into the leech of a sail, the



strand is taken round the rope and through the eyelet hole in the sail; and the ends are finished off by taking a hitch round all, and then passed under two, over one, and under two, as before.

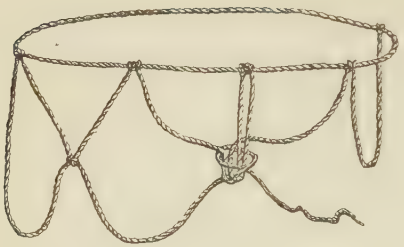
190. NET-MATTING.—Fill the needle, stretch the head-rope along, and begin on the left by securing the end of the twine to it. Regulate the size of the mesh by taking it over your finger, and then clove-hitching it to the head. When you have worked as far to the right as the head is intended to extend, get round on the other side of the net, and work back again; but this row of meshes, and all the subsequent ones, are formed by hitch-



ing them to the upper row with a sheet bend. When the second row is finished, shift round to the other side again, and work the third row. The last row is hitched to the foot-rope, which is weighted with leads; the head-rope is floated with corks; and side-ropes are afterwards seized on.

To repair a seine, you cut it away until you get a straight row of meshes, and replace them as you at first made them.

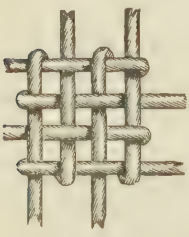
A shot, or treasure-net, is made like a cabbage-net: the head-rope is circular, the meshes are formed in the usual way, and the circumference of the net is reduced as you work down, by bringing two meshes into one, at regular intervals; at first, one mesh in a row; in the next row, two meshes; then taking up every fourth mesh, next every third



in a row, and so on. Finish by working a small grummet through the meshes at the bottom, to keep them together; and reeve two stops through the head for beckets, so that by hauling them apart the mouth of the net is drawn up.

191. BOATS' FENDERS.—A paunch mat fender is made of a piece of mat rolled up taut, with the ends of the foxes placed in the centre; the end is sewed to the part of the mat where it terminates, and the edges are laced together. The lanyard of the mat forms the lanyard of the fender.

The usual fender for boom-boats is made of as many parts of spunyarn as will give it the requisite dimensions. These are middled and doubled over the lanyard, and a small grummet is driven over the bights to make them snug as in making a swab. It is then grafted over, either with sennit or foxes, and finished off as grafting is usually finished; or by crowning the end over with the foxes, as is shown in the left-hand figure.



You can crown in this way with any number of ends that are a multiple of four, by dividing them into four parts, and

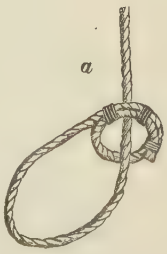
laying a part down on each side ; then bringing 1 over on side 6, keeping the bight up, laying 6 over between 1 and 2, bringing 2 over between 6 and 5, and laying 5 over outside 2 ; then laying 7 over 1, under 6, over 2 and under 5 ; 4 over 5, under 2, over 1, under 6 ; then reeving 8 across and lastly 3 ;—when it will be found that all the ends are secured. Haul the bights taut down, and either put a whipping round underneath, or tuck the ends under the grafting and cut them off.

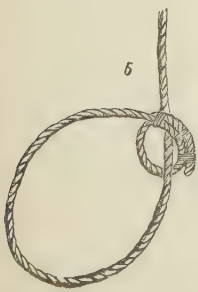
A grummet fender is merely a rope grummet grafted over.

A canvas fender is stuffed with oakum, roped at the edges, and has a small grummet sewed on the centre, to keep the chafe off.

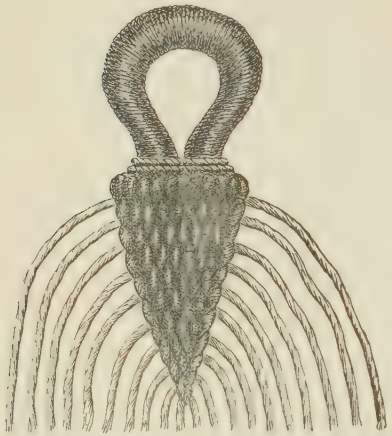
Leather fenders are used for gigs.

192. A CLINCH—Is termed an inside, or an outside one according to the position of the end. In an inside clinch, *a*, the end is protected, and the clinch looks snugger. An outside clinch, *b*, is used for a cable, and in any case where the rope is not permanently secured, and where the strain is such as would jamb an inside clinch.



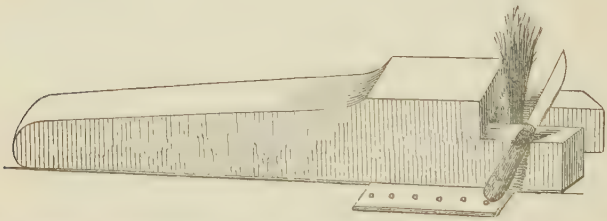


193. Hammock Clews.—Take twelve lengths of nettle-stuff, middle them, serve round all at the centre, and pass a seizing to form the eye ; then lay one up and one down, as for a sword mat, bring the outside nettle on each side across for filling and leave it out ; form the other rows in the same manner, and when reduced to two, knot the last pair.



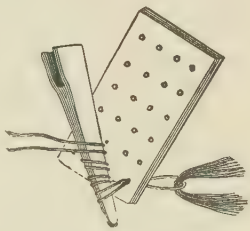
Spanish Clews—Are without plaiting, are made by serving the nettles round below the seizing, leaving one out on each side, at regular intervals.

194. Coir Brushes.—Shape a piece of hard wood for the back (stave of a salt-meat cask, for example), burn out



the holes in rows with a marlinspike ; out of another piece of wood cut a *former*. Make the coir up into fillings pro-

portionate to the size of the holes, pass the bight of the marline down through the first hole, slip it over the filling, take a turn or two round the former, and heave the bight of the filling through the hole, up to the level of the top of the back; then slue over, put the filling between the notch of the former, and cut it off square, dip the bight of the marline down through the next hole, and in the same manner proceed with each, until all are filled in.



195. Units of Measurement.—The size of spars, dead-eyes and chain, is expressed by their diameters; of rope by its circumference; blocks by their length; hand masts (Norway spars), by their circumference, in hands, four feet from the heel (the hand being four inches).

196.—Rogue's Yarn.—Red, Plymouth; blue, Portsmouth; yellow, Chatham.

197, Hawser and Cable-laid.—Hawser laid is the ordinary three or four stranded, right or left-handed rope; cable laid is that of which cables and hawsers are made.

198. Four-stranded Rope—Is laid up with a *heart* in the centre.

199. Rumbowline—Is coarse, soft rope, made from outside yarns, &c.; supplied to a ship fitting out, for temporary lashings, and so forth.

200. Splicing a Three, and Four-stranded Rope together.—For a short splice, divide the fourth strand into three parts, and lay one part in with each of the three

strands. In a long splice, work three strands in as usual; and, when finished, put the fourth strand in where it lies.

201. Splicing a Hawser.—Work a long splice, as with a hawser-laid rope, but, instead of knotting the strands, unlay them, marry them together, and tuck them in under the strand that you would reeve them through if you had knotted them in the usual manner; under this first strand of the hawser put all three strands of the strand; under the next two only, then one, and, lastly, *back* this one.

Long-splicing the strands can only be done with old, soft hawsers, which are not worth the trouble, and for these a shroud-knot, with the ends marled down, and served over, is the best treatment.

202. Splicing a Thimble into a Large Rope.—After one half of each strand is put through, it is cut off; and the other half is opened out, wormed along between the strands and marled down.

203. Anchor-strops, &c.—Put the ends in *twice*, don't cut them off close, but *whip them*.

204. Cable-laid Rope.—Is so laid up to exclude the water.

205. A Ropemaker's Eye—Is used for forming the collars of stays. The stay, four-stranded, is unlaid, two strands each way; then each half is doubled back, and laid up with its own part. At the fork the four strands are worked in, as in splicing, tapering off by thinning the strands each time they are put in. The eyes and forks are then served over.

206. Elliott's Eye.—Put a whipping on the cable a

couple of fathoms from the end, and unlay to it. Splice two strands together with a long splice, making the eye thereby formed equal in length to the diameter of the thimble and the breadth of the seizing; and splice the third strand to its own part, making an eye-splice equal to the eye already formed. Place them together, fid them out, put a piece of rope between them to fill up the hollow, and hitch the eye over with small rope. Seize the thimble in with a round seizing of inch-and-a-half, and heave on a kackling of two-and-a-half-inch rope, two fathoms down from the eye,

207. LENGTH OF A COIL OF ROPE.—Hawser-laid rope, 113 fathoms; cable-laid, 101 fathoms.

208. A SPLICE.—Weakens a rope about one-eighth.

209. STRENGTH OF A YARN.—In round numbers you may call it 100 lbs., but the average strength of each yarn, in hawser-laid rope, is found to be greatest in the smaller sizes; thus, for 12-inch rope, the mean average strength is 76 lbs. per yarn; for 6-inch 78·4 lbs.; for $1\frac{1}{2}$-inch, 93·8lbs.; for 1-inch, 95·2 lbs.; for $\frac{1}{2}$-inch, 104·5 lbs.

210. HAWSER-LAID ROPE.—Is stronger than cable-laid, in the proportion of 8·7 to 6.

211. STRONGEST DESCRIPTION OF HEMP ROPE—Is untarred, white, three-stranded rope; and the next in the scale of strength is the common three-strand, hawser-laid rope, tarred.

212. THREE-STRANDED ROPE—Is one-fifth stronger than four-stranded.

213. PROPORTIONATE STRENGTH OF ROPE OF DIFFERENT SIZES.—To find what number of parts of a small rope are

equal to a larger rope—without allowing for the difference of the angle of twist which affects the strength of the rope—divide the square of the circumference of the larger rope by the square of the circumference of the smaller and the quotient will be the number of parts of the smaller equal to the larger.

214. PRACTICAL RULE FOR ASCERTAINING THE STRENGTH OF HAWSER-LAID ROPE.—Square the circumference and divide by 3 for the breaking strain ; by 4 for the proof strain ; by 6 for the working strain ; the result which is in tons is a very true approximation.

215. RULE FOR CALCULATING THE WEIGHT OF ROPE.—Three strand, hawser laid, 25 thread yarn, tarred. Multiply the square of the circumference by the length in fathoms, and divide by 4·24 for the weight in lbs.

Example.—2 inch rope, 113 fathoms.

$$\frac{2^2 \times 113}{4{\cdot}24} = 106 \text{ lbs.}$$

Actual weight : 105 lbs.

The devisor for hempen cables is 4·79.

Chain cables are about 2·3 heavier than hempen cables of the corresponding size.

216. RULE FOR ASCERTAINING WHAT WEIGHT A ROPE WILL LIFT WHEN ROVE AS A TACKLE.—Multiply the weight the rope is capable of suspending by the number of parts at the moveable block, and subtract one-fourth of this for friction.

217. PRACTICAL RULE FOR DETERMINING THE RELATIVE STRENGTH OF CHAIN AND ROPE.—Consider the proportionate strength of a chain and rope to be ten to one,—using the diameter of the chain, and the circumference of the rope. Half-inch chain may, therefore, replace five-inch rope.

The absolute strength of chain, at the *breaking point*, may be found by dividing the square of the diameter in eighths, by 2·4, for round-linked crane chain; and by 2·7, for chain cable.

Ex. 1. $1\frac{1}{2}$-inch round-link chain,

By experiment, minimum. 58·2 tons; mean, 62·3 tons.

By calculation, $144 \div 2{\cdot}4 = 60$ tons.

Chapter VII.

WIRE ROPE.

218. Manufacture of steel Wire Rope.—During recent years, steel wire rope has practically taken the place of rope for all standing rigging, and flexible steel wire rope the place of hemp for the principal hawsers supplied to ships; owing to its lightness, strength, and durability, wire rope is very largely used on board for a great variety of purposes, slings, lashings, seizings, &c., &c.

When first introduced wire rope was generally made of iron wire, but at the present time "crucible steel wire is invariably used owing to its greater tensile strength.

For Naval work the wire is always 'protected' either by being galvanized, or, in certain cases electro-plated with zinc. Galvanized wire is slightly harder and more brittle than plain "black" wire of similar quality.

The following is the general method of manufacture :— The wire is obtained in the first place by rolling down heated bars of steel into rods of about $\frac{1}{4}$ inch in diameter, which are converted into wire by drawing them, whilst cold through holes in metal plates, as the drawing process continues the wire becomes harder and less ductile and has to be periodically softened and annealed by heat. The result of the drawing process is to very largely increase the tensile strength. After being drawn to the required size, the wire is

annealed, hardened, and tempered, is then subjected to preliminary tests for tenacity, torsion and elasticity, it is then made up into coils and cleaned in acid, after which it is galvanized, being first drawn through a bath of acid, and then through the galvanizing bath; on emerging from the latter, it passes through a bed of sand or asbestos, and is wound on reels; the wire is then tested again.

The wires to form the strand, which vary in size according to the dimensions of the rope required, or the strands to form the rope, (for the process is the same in each case), having been coiled on bobbins are then placed on a machine, they are then unwound or drawn off from the bobbins as the machine revolves and at the same time the hempen or wire heart is drawn in centrally from the back of the machine; by a special arrangement the "turn" is prevented from being taken in the wire; after the wires leave the bobbins they converge towards a cone shaped "nozzle" which has six grooves cut in it, and which is bored through its axis for the passage of the core or heart; the grooves guide the strands or wires, as the case may be, in the necessary direction for forming the rope, and after emerging from the grooves the strands pass through a stationary nut or die known as the "lay plate," which exactly fits the rope, this completes the closing, and keeps back any undue slack in the wires paid off by the bobbins. The

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I am indebted to the courtesy of Messrs. Bullivant (London) for much information about wire rope, also to Messrs. Smith (Newcastle) for the process of electro-plating wire. T. P. W.

distance between the nut and the end of the nozzle, and the velocity with which the wire is drawn off the bobbins, determines, to a certain extent, the length of the twist, or the lay of the rope, the longer the lay, the less violence is done to the texture of the metal when a heavy strain is put on the rope, but naturally there is a limit to the looseness with which the strands may be closed. The wires forming the strands are generally laid or twisted to the left hand, whilst the strands forming the rope are closed in the opposite direction.

The core, or heart of wire rope is composed of either hemp or wire, it is usual to steep the hemp in hot linseed, or other vegetable oil. All wire rope supplied to the Navy has a jute yarn running through the heart as the Government mark, there is no distinguishing colour.

In wire rope used for rigging &c., the heart of each strand is formed of wire, and the strands are formed round a hemp heart.

In flexible steel wire of all descriptions, each strand has a hemp heart, and the strands themselves are also formed round a hemp heart.*

The flexibility of the rope lies principally in the multiplication of the number of wires of which it is made, or the fineness of the wire, and the way they are laid ; this number may range between 16 and 400. Hemp hearts also give a more flexible rope.

* This latter only refers to Bullivant's wire.

As a general rule 6 strands are used to form a rope. For example, a 6 inch flexible steel wire hawser is made of 6 strands formed round a hemp heart, each strand has a hempen heart covered with layers of 12, and then 18 wires ; there would thus be 180 wires in the hawser. Each wire is No. 13 S. W. Guage.

The quality of wire rope used in the Service is that which is described as "Crucible steel," what is really supplied is Siemens-Martins steel, that is, an open hearth steel, and it is not a crucible steel in the old acceptation of the word. There is an Admiralty specification for flexible steel wire rope which is used for hawsers and running rigging, and another specification for steel wire rope for standing rigging. The quality of steel used in each instance is the same, but the make of the rope different, the flexible rope is a soft rope, and will therefore stretch to a considerable extent, the standing rigging is a rigid rope and will stretch very little, the rigidity is essential, elasticity is not necessary and stretching would be detrimental.

A process of electro-plating with zinc the wire used in the manufacture of wire rope, has in recent years, been introduced with considerable success. In this process the wire is passed through a cold bath and the zinc is deposited electrically, by this means a high steel can be utilized, which in the galvanizing process is hardly possible, owing to the temperature to which the wire is raised when passing through the galvanizing bath. This wire has been to a certain extent

introduced into the Service, it is more costly than the galvanized wire, and has a very high breaking strain; it is used in the tackles connected with hydraulic work, the purchases of the hydraulic cranes of H.M.S. "Vulcan" may be quoted as an example of its use.

Its manufacture is similar to that already described, but its flexibility is mainly dependent on the fineness of the wire composing the rope, in all cases each strand is composed entirely of wires, the strands themselves being made up round a hemp heart.*

TESTS to which flexible steel wire hawsers are subjected before being accepted for the Service,

(1). *Tensile test.*—About two or three fathoms of the hawser is cut off, and by means of hydraulic power tested to the required proof strain. Fourteen wires are then unlayed to be tested, seven for Torsion, and seven for Ductility.

(2). *Torsion test.*—Each of the seven wires selected is separately tested. One end of the wire is rigidly held in a small machine which is then revolved, so as to take about 25 turns in the wire (the number of turns varying with the size of the hawser,) the wire should show no signs of breaking under this test. If two of the wires fail the hawser is probably rejected.

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* The ropes supplied for use on the hydraulic gear of H.M.S. "Vulcan," "Sanspareil," and other new ironclads, are made of extra special flexible construction, viz.—6 strands each containing 37 wires, the wires are electro-plated with zinc. The wire of which these special ropes are made has a tensile strength of about 120 tons per square inch.

(3). *Ductility test.*—Each of the second set of seven wires is separately tested. One end of the wire is clamped in a kind of vice, the other end is then rove through a loop or over a hook close to the vice, and then twisted round its own part about 8 times (the number varying with the size of the hawser), it is then untwisted and should show no signs of breaking If two of the wires fail, the hawser is probably rejected.

219. IRON WIRE ROPE.—No iron wire rope is now used in the Service, except for seizings, or similar work.

220. PRACTICAL RULE FOR ASCERTAINING THE STRENGTH OF STEEL WIRE ROPE.—For rigging wire, to ascertain the breaking strain, square the circumference and multiply by $2\frac{1}{2}$ the result in tons gives a very good approximation.

Example (1). 4-inch rigging wire,

By Tables. Breaking strain = 40 tons.

By Calculation. ,, = 40 tons.

Example (2). $6\frac{1}{2}$-inch rigging wire.

By Tables. Breaking strain = 106 tons.

By Calculation. ,, = $105\frac{5}{8}$ tons.

For Flexible steel wire, square the circumference and multiply by 2 for hawsers up to and including $4\frac{1}{2}$ inch above $4\frac{1}{2}$ inch the factor should be $2\frac{1}{4}$ the result in tons gives a rough approximation.

221. WORKING STRAIN FOR STEEL WIRE ROPE.—The usual margin of safety allowed in working steel wire rope for a purchase, or tackle is, that the ropes should not be worked at more than one-sixth their breaking strain.

222. RELATIVE STRENGTH OF FLEXIBLE STEEL WIRE ROPE, AND STEEL WIRE RIGGING ROPE.—With respect to the relative

breaking strain of flexible steel wire rope, and rigging steel wire rope, both being Navy rope, the rigging rope is considerably stronger than the flexible rope, up to $4\frac{1}{2}$ inches in circumference. This is due to the fact that instead of having a hempen heart, the strand is of solid wire. Above 5 inches circumference the difference is not so marked, owing to the fact that there is a very much smaller proportion of hemp in the flexible rope than in the smaller sizes.

The wire used in the rigging rope is of larger size than that used in the flexible rope, and the breaking strain per square inch of the wire can be increased, the finer the wire is drawn.

223. General directions for the care of Flexible steel hawsers.—The hawser should always be kept coiled on the reel supplied for the purpose, when not in use.

The hawser should be kept well oiled (Linseed oil being used). This should be done every few months.

The hawsers may be taken round any bitt or bollards, round which a hemp hawser of similar strength would work, but these should always be as large as possible, and care should be taken to avoid sharp nips and bends.

A thimble is spliced into the end of the hawser, and when making it fast to a ring it is advisable to shackle it on to the ring, as constantly hitching the hawser back on its own part is likely to injure it.

There is no particular size to regulate the thimbles, except that it must not be so small as to distort the lay of the rope by being bound round it. Stress is laid on sheaves and

barrels being of a given size, because a rope has to work round them, which is a different condition to being permanently fixed in a given position.

224. Regulations for wire rope in the Merchant Service.—Lloyd's requirements for the Merchant Service are much less than the Admiralty requirements, Lloyd's admit of steel, in substitution of iron, taking only 45 tons to the square inch, their regulations also state, that a certain given size of iron rope is to be used, but they admit a smaller size of 45 tons steel, they make no further reduction in size if a better quality of steel is used.

Note :—For Lloyd's requirements for the Merchant Service, see Tables at end of "Instructions for Officers of the Merchant Service."

Patent Galvanized Flexible Steel Wire Hawsers.

Table showing the number of strands, number of wires, weight per fathom and the breaking strain of galvanized steel wire rope supplied to the Navy.

Size of rope.	Strands in a rope.	Wires in a strand.	Weight per fathom.	Breaking strain to be not less than
Inches	Inches	Number	lbs.	Tons
8	6	30	53	148
7	6	30	41	113
6½	6	30	35	98
6	6	30	31	84
5½	6	24	28	71
5	6	24	23	59
4½	6	12	15	39
4	6	12	12	31
3½	6	12	9	24
3	6	12	7	17
2¾	6	12	5½	14½
2½	6	12	4½	11¾
2¼	6	12	3⅝	9
2	6	12	2¾	7
1¾	6	12	2	5½
1½	6	12	1¾	4
1¼	6	12	1¼	2⅞
1	6	12	¾	1¾

All hawsers below 4½ inch are supplied to the Dockyard in coils containing from 240 to 360 fathoms of wire rope; lengths are then cut off and fitted as required.

Hawsers of and above 4½ inch are supplied in 150 fathom lengths.

Patent Flexible Steel Wire Hawsers and Cables.

COMPARED WITH HEMP AND CHAIN.

FOR DETAILS AS TO WIRE HAWSERS SUPPLIED TO THE NAVY

VIDE PREVIOUS TABLE ON PAGE 126.

(*Bullivant's*).

Patent Flexible Steel Wire Hawsers and Cables.				Chain Cable.				Short Link Chain.			Tarred Hemp Ropes.		
Size Circumference.	Weight per Fathom.	Guaranteed breaking Strain.	Diameter of Barrel or Sheave round which it may be at a slow speed worked.	Size.	Weight per fathom.	Proof Strain.	Breaking Strain.	Size.	Proof Strain.	Breaking Strain.	Size.	Weight per Fathom.	Breaking Strain.
In.	Lbs.	Tns.	Inches	In.	Lbs.	Tns.	Tns.	In.	Tns.	Tns.	Ins.	Lbs.	Tns.
12	115	320	72										
11	97	270	66										
10	80	220	60										
9	65	180	54										
8	53	150	48	$2\frac{5}{16}$	280	$96\frac{1}{4}$	$134\frac{3}{4}$	..	...	...	25	146	125
$7\frac{1}{2}$	47	130	45	$2\frac{9}{16}$	256	$86\frac{1}{2}$	$120\frac{1}{2}$	...	...	...	24	134	115
7	41	116	42	$2\frac{1}{16}$	231	$76\frac{1}{2}$	$107\frac{1}{10}$	...	...	...	23	123	106
$6\frac{1}{2}$	37	102	39	$1\frac{15}{16}$	204	$67\frac{1}{2}$	$94\frac{1}{2}$	...	...	...	21	106	89
6	33	88	36	$1\frac{3}{4}$	166	$55\frac{1}{8}$	$77\frac{1}{8}$	...	...	...	19	84	72
$5\frac{1}{2}$	28	74	33	$1\frac{5}{8}$	143	$47\frac{1}{2}$	$66\frac{1}{2}$	...	...	...	17	67	60
5	$23\frac{1}{2}$	64	30	$2\frac{7}{16}$	112	$37\frac{1}{8}$	$55\frac{1}{2}$	...	...	...	15	56	50
$4\frac{1}{2}$	15	39	27	$1\frac{1}{8}$	68	$22\frac{3}{4}$	$34\frac{1}{8}$	...	..	...	13	39	34
4	12	33	24	1	54	18	27	$1\frac{1}{8}$	15	34	12	33	29
$3\frac{1}{2}$	9	26	21	$1\frac{5}{16}$	48	$15\frac{9}{16}$	$23\frac{7}{10}$	1	12	26	11	28	$24\frac{1}{2}$
$3\frac{1}{4}$	8	22	$19\frac{1}{2}$	$1\frac{3}{16}$	35	$11\frac{7}{8}$	$17\frac{8}{10}$	$\frac{15}{16}$	$10\frac{1}{2}$	23	10	23	20
3	7	18	18	$1\frac{2}{16}$	30	$10\frac{1}{8}$	$15\frac{1}{8}$	$\frac{13}{16}$	8	17	9	19	$16\frac{1}{2}$
$2\frac{3}{4}$	$5\frac{1}{2}$	15	$16\frac{1}{2}$	$1\frac{1}{16}$	25	$8\frac{1}{2}$	$13\frac{3}{4}$	$\frac{3}{4}$	$6\frac{3}{4}$	15	$8\frac{1}{2}$	16	14
$2\frac{1}{2}$	$4\frac{1}{2}$	12	15	...	...	...	..	$\frac{11}{16}$	$5\frac{5}{8}$	12	$7\frac{1}{2}$	13	$11\frac{1}{2}$
$2\frac{1}{4}$	$3\frac{3}{4}$	9	$13\frac{1}{2}$	$\frac{10}{16}$	21	7	$9\frac{1}{2}$	$\frac{5}{8}$	$4\frac{5}{8}$	10	$6\frac{1}{2}$	$11\frac{1}{4}$	10
2	$2\frac{3}{4}$	7	12	..	...	...	...	$\frac{1}{2}$	3	6	$5\frac{3}{4}$	9	8
$1\frac{3}{4}$	2	$5\frac{1}{2}$	$10\frac{1}{2}$	$\frac{9}{16}$	17	$5\frac{1}{2}$	$7\frac{1}{4}$	...	...	...	5	$6\frac{1}{2}$	6
$1\frac{1}{2}$	$1\frac{3}{4}$	4	9	...	...	...	...	...	...	...	4	4	4
$1\frac{1}{4}$	1	$2\frac{1}{2}$	$7\frac{1}{2}$	$\frac{1}{2}$	14	$4\frac{1}{5}$	6	...	...	...	$3\frac{1}{2}$	$3\frac{1}{4}$	$2\frac{3}{4}$
1	$\frac{3}{4}$	$1\frac{3}{4}$	6	...	...	...	...	...	...	...	$2\frac{3}{4}$	2	$1\frac{3}{4}$

In the above table, the diameter of the sheave or barrel is given, on the supposition that the speed is slow. The diameter must be increased with the speed at which the rope is worked, and *this especially applies to the case of lifts.* In all cases the diameter of both barrels and sheaves should be as large as practicable.

Galvanized Steel and Iron Wire Rope,

FOR RIGGING PURPOSES,

(Bullivants'.)

STEEL WIRE ROPE FOR STANDING RIGGING.

Size.	No. of Wires in a Strand.	No. of Strands in a Rope.	Weight per Fathom.	Breaking Strain
Inches.				
8 circum.	19	6	62 lbs.	160 tons.
7½ ,,	19	6	53 ,,	141 ,,
7 ,,	19	6	46 ,,	123 ,,
6½ ,,	19	6	40 ,,	106 ,,
6 ,,	19	6	34 ,,	90 ,,
5½ ,,	19	6	28 ,,	76 ,,
5 ,,	19	6	23 ,,	63 ,,
4½ ,,	19	6	19 ,,	51 ,,
4 ,,	7	6	15½ ,,	40 ,,
3½ ,,	7	6	11½ ,,	32 ,,
3¼ ,,	7	6	10 ,,	27 ,,
3 ,,	7	6	8 ,,	24 ,,
2¾ ,,	7	6	7 ,,	19 ,,
2½ ,,	7	6	6 ,,	16 ,,
2¼ ,,	7	6	5 ,,	13 ,,
2 ,,	7	6	4 ,,	10 ,,
1¾ ,,	7	6	3 ,,	8 ,,
1½ ,,	7	6	2 ,,	6 ,,
1¼ ,,	7	6	1½ ,,	3 17/20 ,,
1 ,,	7	6	1 ,,	2 10/20 ,,

Table showing the number and size of Wire and Hempen hawsers supplied to different ships in the Navy.

STEEL WIRE HAWSERS (fitted).

Length.	Size.	Nos. supplied	Remarks.	
150 fms.	6½"	1	For ships of 9000 tons and over.	Square rigged.
,,	6 ,,	1	,, ,, ,, 5000 ,, and under 9000	
,,	5½ ,,	1	,, ,, ,, 2500 ,, ,, ,, ,, ,, 5000	
,,	5 ,,	1	,, ,, ,, 1800 ,, ,, ,, ,, ,, 2500 and over 9000 tons.	
,,	4½ ,,	1	For ships of 1000 and under 1800 tons and of 3500 and under 9000 tons.	
120 fms.	4 ,,	1	For ships of 750 and under 1000	
,,	3½ ,,	1	,, ,, 450 ,, ,, 750 and over 1000 tons.	
,,	3 ,,	1	For ships of 300 and under 450 and for ships over 750 and under 1000 tons.	
,,	2½ ,,	1	For ships under 5000 tons if demanded, then to be in lieu of the medium size allowed.	
150 fms.	6½ ,,	1	For the ships 9000 tons and over	Other than Square rigged.
,,	6 ,,	1	,, ,, 5000 ,, under 9000	
,,	5½ ,,	1	,, ,, 4000 ,, ,, 5000 and of 9000 tons and above.	
,,	5 ,,	1	For ships of 3000 and under 4000 tons and for ships of 5000 and under 9000 tons.	
,,	4½ ,,	1	For ships of 2000 and under 3000 and of 9000 tons and above.	
120 fms.	4 ,,	1	For ships of 1500 and under 2000 tons.	
,,	3½ ,,	1	,, ,, ,, 520 ,, ,, 1500 and of 2000 tons and above.	
,,	3 ,,	1	For ships of 1500 and under 2000 tons.	
,,	2½ ,,	1	,, ,, ,, 520 ,, ,, 1500 and ,, ,, 2000 ,, ,, 9000 under 520 tons if demanded.	

Note. If fitted with steel Wire hawser in lieu of chain cable for spare anchor, it will take the place of the largest steel wire hawser allowed.

Length.	Size.	Nos. supplied,	Remarks.	
113 fms.	8″	2	For ships of 5000 tons and above.	Square rigged.
,,	7″	2	,, ,, 1800 ,, and under 5000, and for special class.	
,,	7″	1	For ships of 5000 tons and over.	
,,	6″	1	,, ,, 900 ,, ,, and Training Brigs.	
,,	5″	1	For ships of 300 tons and over.	
,,	4½	2	For Special class and Training Brigs.	
,,	4″	1	For ships of 900 and under 5000 tons. Not allowed to Special class.	
,,	3½	1	For ships under 1800 tons, if demanded.	
160 fms.	10″	1	For seagoing tugs, if demanded	Other than Square rigged.
113 ,,	8″	2	For ships of 11000 tons and over.	
,,	8″	1	,, ,, 3000 ,, and under 11000 tons	
,,	7″	1	For vessels of 5000 and under 11000 tons 113 fms. in addition for "Hecla" and "Vulcan."	
,,	6″	1	For vessels of 1000 tons and over, 113 fms. in addition for "Hecla" and "Vulcan."	
,,	5½	1	For vessels of 700 and under 1000 tons.	
,,	5″	1	For vessels of 400 tons and under 700 and for ships of 1000 tons and over.	
,,	4½	1	For vessels of 700 and under 1000 tons, and for vessels under 400 tons.	
,,	4″	1	For ships of 1000 and under 5000 tons 226 fms. for "Hecla" and "Vulcan."	
,,	3½	1	For ships under 700 tons.	
			For ships above 700 and under 1000 if demanded.	

COIR HAWSER.

Length.	Size.	Nos supplied.	Remarks.	
113 fms.	8″	1	Special class and Training Brigs.	Square rigged.
,,	5″	1	Ships of 5000 tons and over.	
,,	4″	1	Ships of 2000 tons and over. and for Ships 500 and under 2000 tons if demanded.	
,,	3″	1	For ships of 500 and under 5000 tons and for Training Brigs.	
,,	2½″	1	For ships under 500 tons.	
,,	5″	1	For ships of 7000 tons and over.	Other than Square rigged.
,,	4″	1	,, ,, ,, 4000 ,, ,, ,, 113 fms. in addition for "Hecla" and "Vulcan"	
,,	3″	1	For ships of 7000 and under 7000 tons 113 fms. in addition for "Hecla" and "Vulcan"	
,,	2½″	1	For ships under 700 tons.	

Chapter VIII.

ORGANIZATION, STOWAGE OF HOLDS, PROVISIONS, &c.

225. Berthing Ship's Company.—Each man should have his hammock berth allotted to him, and should not be allowed to change it without permission. The general plan is to arrange that as far as is possible the men should be berthed over their own messes, special places being reserved for various ratings, such as Boatswain's Mates, Quarter Masters, Buglers, Ship's Police, &c. Boatswain's Mates, sleep near the Hatchways, Boys berthed together with a Ship's Corporal in charge, the Guard, Quarter Masters, Signalmen, &c., being placed where they will be disturbed as little as possible.

Another plan of Berthing is to begin on one side forward and number off right across, 1, 2, 3, 4, &c ; in this way when one watch is on deck at night, every other hammock is empty and the same number of men off each side of the deck. It is difficult in a modern Ship to carry out this method effectually, owing to the way in which the deck is cut up by Funnel casing, and various obstructions.

Hammock hooks should as a general rule be 15 inches apart, allowing when practicable more room for Petty Officers.

Each man should have a bag and hammock given to him which should be marked with his number on the Watch Bill, Marines marked in red.

When in Harbour it is a good plan to tell off a night boat's crew who should be berthed together.

226. MESSES.—Every mess should have the same number of men from each watch belonging to it, also if possible tell them off equally from the 1st and 2nd parts of watches, so that the weight may be equal when one watch is on deck ; also that you may have enough hands in the watch below to clean it.

Each mess also has a leading seaman or second class petty officer told off in charge of it, who is responsibe for the accounts of the mess and for its general order and conduct.

The King's Regulations and Admiralty Instructions lay down, that, the Master-at-arms, the Naval Schoolmaster, and the Writers, including the Boy Writers, are to mess together. The other Chief Petty Officers are either to mess together or with the first class Petty officers. A sufficient number of boys from each watch are to be attached to these messes to do the work of cooks of messes.

The Chief or other Engine Room Artificers are to form a separate mess, and a stoker told off for them as cook of the mess.

Chief Stokers are to mess with the Chief Petty Officers, and not with the Engine Room Artificers.

The Ship's Steward, Cooper, Steward's assistant and Boy, are *not* to form a mess together.

In addition to the above being followed out, it is generally the custom to allow the following to form messes by themselves, viz.—First-Class Petty officers, Ship's Corporals, Shipwrights, Idlers, Sick Berth Staff, Signalmen, Leading stokers, Stokers, Sergeants, Marines, Marine wardroom servants, Band. Officers' Stewards and Domestics to be messed in the messes to which they belong.

Boys, except those told off for Petty Officers' Messes, should be messed with their own parts of the ship,

227. Caterer of Mess when no Leading Seaman, or Second Class Petty Officer is available.—Tell off the senior able seaman with a good conduct badge.

228. Cooks of Messes.—Two cooks, one from each watch are told off daily, or on every Monday to act for the week. They are taken in rotation from the list and their names given in to the Master-at-arms by the caterer of the mess. The duties of the cook of the watch below are; to clear up the mess, draw the rations, prepare the food, take it up to the galley, get meals from the galley, keep meals hot for men away on duty, attend at the issue of rum, get provisions up out of the hold, after meals to clear up the mess and clean the mess traps, attend the Rounds, and generally to keep the mess in order. Cooks of the watch on deck work with the watch.

229. Duties of Caterers of Messes.—They are responsible for the accounts of the mess, and for its general order and cleanliness, also that there is no gift, sale or transfer of spirits, wine, or grog by any person in their mess,

also that there are no men below when their duty requires them elsewhere, and generally for the good order and conduct of the mess.

230. TELLING OFF SIDE PARTY, MESSENGERS, SIDE BOYS, LOWER DECK SWEEPERS, &c.—The side party are generally told off for 3 or 6 months, with a petty officer in charge, and are taken equally from the parts of the ship. Messengers, side boys, lower deck sweepers, &c., are generally told off monthly, and are taken equally from the parts of the ship.

231. PETTY OFFICER OF THE DAY.—A Petty Officer, 1st class, should be told off as Petty Officer of the day, his duty, in addition to his ordinary work, is to attend all issues of spirits, provisions, clothes, soap and tobacco, &c. He should be the medium of communication between the ship's company and the Officer of the Watch, and should forward to him all general complaints about provisions, &c. Complaints as to provisions should be made through the Petty Officer of the day, and the Master-at-arms, to the Officer of the Watch and through him to the Commander or First Lieutenant.

232. ISSUE OF RUM.—The issue of rum is superintended by the Gunner, who obtains the key of the Spirit room from the Sentry, and is responsible that the proper regulations as to the issue are adhered to. The spirit room is opened at six bells in the forenoon, there being present the Gunner, the Ship's Steward, the Petty Officer of the Day, the Sergeant of the Guard, Senior Ship's Corporal, Captain of the Hold, Cooper, and Cooks of messes of the watch below (if required), the rum is then measured off into the rum breaker, taken on to the main deck, the "neat" rum is then drawn off

from the breaker and issued, in accordance with the Regulations, to the Warrant Officers and Chief Petty Officers, after which the rum breaker is placed under the Sentry's charge. At one bell, the same Officers and men being present, the rum is mixed with water, three of water to one of rum, and served out to the Cooks of messes. Any surplus remaining after the issue is over, is started down the scupper, or shoot on deck. No one under the age of 20 is allowed to take up rum.

233. Stationing a Ship's Company at Quarters.—First station the men duly qualified as captains of guns to the various guns, then station the seamen gunners to the important numbers at guns and magazines, the torpedo men to the torpedo tubes and various duties connected with torpedo work, the guns' crews then to be filled up from the seamen, the marines are stationed at the guns in such a manner so as to cause the least inconvenience should they be landed, a certain number of them should if possible be told off as a small arm party. Pick out good shots from the seamen as top-riflemen ; a small party of men are told off as riggers ; magazine men and shell room parties are taken from the idlers with the addition probably of some seamen ; the carpenters and a party of stokers form the fire brigade. In addition to the above, men will be required for the wheel, relieving tackles, lead, signals, care of wounded, voice tubes, messengers, &c.

The officers fall into station according to their various duties.

234. Size of Water Tanks.—The largest tank contains 600 gallons, is 4 feet 1 inch square at the ends, and 6 feet 1 inch, in height, the next size contains 500 gallons, and is 4 feet 1 inch, by 5 feet 1 inch ; and the 400 gallon tank 4 feet 1 inch square ; these tanks, empty, weigh ten, eight, and six hundred-weight, respectively, the bilge tanks have their lower outer edge taken off, otherwise they are of the foregoing dimensions.

In some ships built at the present time, tanks as described above are not used, but compartments are built or enclosed in the ship for the stowage of water.

235. Stowing Tanks.—Tanks are stowed on a skeleton platform, built at the bottom of the hold, placed with their tops level, and with the corners in which the manholes are, adjoining, so that when watering, or pumping out, four tanks can be filled or cleared without shifting the hose more than a foot or two.

They should be wedged up taut, and caulked in. Tanks are slung with a toggle in the manhole, and placed with levers and tackles.

236. Starting a Tank.—In one corner of the tank is a rod, the lower part of which acts as a plug, and screws into a socket in the bottom. The upper end comes up through the top of the tank, and turns with a key, which lets the water out below ; and to keep it fair over the hole for screwing in again, it traverses between two iron stays near the bottom.

237. Provisions.—Wet provisions are salt beef, pork, suet, vinegar, lime juice, and rum. Dry provisions are peas, flour, raisins, tea, sugar, chocolate and oatmeal.

238. Old Provisions—Should always be cleared out of the hold before stowing the new ; when the new are stowed, the old must be stowed on top, to be consumed first.

239. How, and where stowed.—Provisions should be stowed in the holds, so that each kind can be got at, in due proportion without breaking bulk ; and as much in accordance with the following plan as possible.

Wet provisions being the heaviest form the ground tiers, the dry provisions on the top ; beef and flour on the starboard side, pork and peas port side.

Casks are stowed fore-and-aft, bung up and bilge free, firewood or *dunnage* being placed under the *chines*, to prevent their shifting.

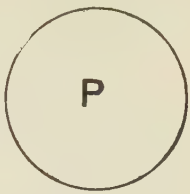
In the spirit room, the casks are stowed bung up, and bilge free ; spirits should be carefully guarded, until the key is turned in the lock of the spirit room. Biscuit is stowed in cases and bags in the bread room.

Before commencing to stow, the holds should be throroughly cleansed, and white-washed or painted.

240. Casks marked.—Each cask has the contents, the date of package, &c., &c., marked on it. The bung is found between the rivets of any two opposite hoops.

The following examples taken from casks will give a general idea of the manner in which they are marked.

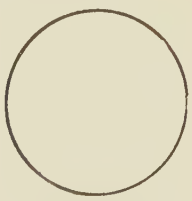
R C represents Royal Clarence Victualling Yard,
J K represents the Contractor's Initials.



No. 30 represents the number of the cask.

200 represents 200 lbs.

Head and Chines are painted white.



26 7/8 represents 26gals. 7 pints. Chines painted red.

187 represents 187 lbs.

20 represents 20 hats. 2s. 8d. represents price of each hat.

In some cases the marks are scribed on with a scribing iron, in others they are stenciled.

241. Slops—Consist of bales of cloth, flannel, drill, duck, jean, silk handkerchiefs, and bedding ; casks of shoes, Marine clothing, soap and tobacco.

242. Ballast.—There are two sizes, weighing $1\frac{1}{2}$ and 3 cwt. each, they are six inches square at the ends ; the largest is three feet long, the smaller of course half that length.

243. DAILY RATIONS :—

Daily.	Biscuit $1\frac{1}{4}$ lb. or Soft bread $1\frac{1}{2}$ lb. Sugar 2 ozs. Cholate 1 oz. Tea $\frac{1}{4}$ oz. Rum $\frac{1}{2}$ gill.
Weekly.	Oatmeal 3 oz. Mustard $\frac{1}{2}$ oz. Pepper $\frac{1}{4}$ oz. Vinegar $\frac{1}{4}$ pint.
Daily (when procurable.)	Fresh meat 1lb. Vegetables $\frac{1}{2}$ lb.
Every other day	Salt pork 1lb. Split peas $\frac{1}{3}$lb. Celery seed $\frac{1}{2}$oz. to every 8lbs. of split peas put into the coppers.
On one alternate day.	Salt beef 1 lb. Flour 9 oz. Suet $\frac{3}{4}$ oz. Raisins $1\frac{1}{2}$ oz.
On the other alternate day.	Preserved meat $\frac{3}{4}$ lb. with either (1) Preserved potato 4 oz. or (2) Rice 4 oz. or 3{ Preserved potato 2 oz and Rice 2 oz. or Flour 9oz, Sue $\frac{3}{4}$ oz. Raisins $1\frac{1}{2}$ oz.

REGULATIONS FOR PREVENTING COLLISIONS AT SEA.

PRELIMINARY.

These Rules shall be followed by all vessels upon the high seas and in all waters connected therewith, navigable by sea-going vessels.

In the following Rules every steam-vessel which is under sail and not under steam is to be considered a sailing-vessel, and every vessel under steam, whether under sail or not, is to be considered a steam-vessel.

The word "steam-vessel" shall include any vessel propelled by machinery.

A vessel is "under way" within the meaning of these Rules when she is not at anchor, or made fast to the shore or aground.

Rules concerning Lights, &c.

The word "visible" in these rules when applied to lights, shall mean visible on a dark night with a clear atmosphere.

Art. 1. The Rules concerning lights shall be complied

with in all weathers from sunset to sunrise, and during such time no other lights which may be mistaken for the prescribed lights shall be exhibited.

Art. 2. A steam-vessel when under way shall carry—

(*a*) On or in front of the foremast, or if a vessel without a foremast, then in the fore part of the vessel, at a height above the hull not less than 20 feet, and if the breadth of the of the vessel exceeds 20 feet, then at a height above the hull not less than such breadth, so, however, that the light need not be carried at a greater height above the hull than 40 feet, a bright white light, so constructed as to show an unbroken light over an arc of the horizon of 20 points of the compass, so fixed as to throw the light 10 points on each side of the vessel, viz., from right ahead to 2 points abaft the beam on either side, and of such a character as to be visible at a distance of at least 5 miles.

(*b*) On the starboard side a green light, so constructed as to show an unbroken light over an arc of the horizon of 10 points of the compass, so fixed as to throw the light from right ahead to 2 points abaft the beam on the starboard side, and of such a character as to be visible at a distance of at least two miles.

(*c*) On the port side a red light, so constructed as to show an unbroken light over an arc of the horizon of 10 points of the compass, so fixed as to throw the light from right ahead to 2 points abaft the beam on the port side, and of such a character as to be visible at a distance of at least 2 miles.

(*d*) The said green and red side-lights shall be fitted with inboard screens, projecting at least 3 feet forward from the light, so as to prevent these lights from being seen across the bow.

(*e*) A steam-vessel when under way may carry an additional white light similar in construction to the light mentioned in sub-division (*a*). These two lights shall be so placed in line with the keel that one shall be at least 15 feet higher than the other, and in such a position with reference to each other that the lower light shall be forward of the upper one. The vertical distance between these lights shall be less than the horizontal distance.

Art. 3. A steam-vessel when towing another vessel shall, in addition to her side-lights, carry two bright white lights in a vertical line one over the other, not less than six feet apart, and when towing more than one vessel shall carry an additional bright white light, 6 feet above or below such lights, if the length of the tow, measuring from the stern of the towing-vessel to the stern of the last vessel towed exceeds 600 feet. Each of these lights shall be of the same construction and character, and shall be carried in the same position as the white light mentioned in Article 2 (*a*), except the additional light, which may be carried at a height of not less than 14 feet above the hull.

Such steam-vessel may carry a small white light abaft the funnel or aftermast for the vessel towed to steer by, but such light shall not be visible forward of the beam.

Art. 4. (*a*) A vessel which from any accident is not under command, shall carry, at the same height as the white light mentioned in Article 2 (*a*), where they can best be seen, and if a steam vessel in lieu of that light, two red lights in a vertical line, one over the other, not less than 6 feet apart, and of such a character as to be visible all round the horizon at a distance of at least 2 miles ; and shall by day carry in a vertical line one over the other, not less than 6 feet apart, where they can best be seen, two black balls or shapes, each two feet in diameter.

(*b*) A vessel employed in laying or in picking up a telegraph cable shall carry in the same position as the white light mentioned in Article 2 (*a*), and if a steam-vessel, in lieu of that light, three lights, in a vertical line one over the other, not less than 6 feet apart. The highest and lowest of these lights shall be red, and the middle light shall be white, and they shall be of such a character as to be visible all round the horizon, at a distance of at least 2 miles. By day she shall carry in a vertical line, one over the other, not less than six feet apart, where they can best be seen, three shapes of not less than 2 feet in diameter of which the highest and lowest shall be globular in shape and red in colour, and the middle one diamond in shape and white.

(*c*) The vessels referred to in this Article when not making way through the water shall not carry these side-lights, but when making way shall carry them.

(*d*) The lights and shapes required to be shown by this Article are to be taken by other vessels as signals that the vessel showing them is not under command, and cannot therefore get out of the way.

These signals are not signals of vessels in distress and requiring assistance. Such signals are contained in Article 31.

Art. 5. A sailing-vessel under way, and any vessel being towed shall carry the same lights as are prescribed by Article 2 for a steam-vessel under way, with the exception of the white lights mentioned therein, which they shall never carry.

Art. 6. Whenever, as in the case of small vessels under way during bad weather, the green and red side-lights cannot be fixed, these lights shall be kept at hand, lighted and ready for use; and shall, on the approach of or to other vessels, be exhibited on their respective sides in sufficient time to prevent collision, in such manner as to make them most visible, and so that the green light shall not be seen on the port side, nor the red light on the starboard side, nor if practicable more than two points abaft the beam on their respective sides.

To make the use of these portable lights more certain and easy, the lanterns containing them shall each be painted outside with the colour of the light they respectively contain, and shall be provided with proper screens.

Art. 7. Steam vessels of less than 40 and vessels under oars or sails, of less than 20 tons, gross tonnage, respectively, and rowing boats when under way, shall not be obliged to carry the lights mentioned in Article 2 (*a*) (*b*) and (*c*), but if they do not carry them they shall be provided with the following lights :—

1. Steam-vessels of less than 40 tons shall carry:

(*a*) In the fore part of the vessel, on or in front of the funnel where it can best be seen, and at a height above the gunwale of not less than 9 feet, a bright white light, constructed and fixed as prescribed in Article 2 (*a*), and of such a character as to be visible at a distance of at least 2 miles.

(*b*) Green and red side-lights constructed and fixed as prescribed in Article 2 (*b*) and (*c*) and of such a character as to be visible at a distance of at least 1 mile, or a combined lantern showing a green light and a red light from right ahead to 2 points abaft the beam on their respective sides. Such lantern shall be carried not less than 3 feet below the white light.

2. Small steamboats, such as are carried by sea-going vessels, may carry the white light at a less height than 9 feet above the gunwale, but it shall be carried above the combined lantern mentioned in sub-division 1 (*b*).

3. Vessels under oars or sails, of less than 20 tons, shall have ready at hand a lantern with a green glass on one side and a red glass on the other, which, on the approach of or to other vessels, shall be exhibited in sufficient time to prevent collision, so that the green light shall not be seen on the port side, nor the red light on the starboard side.

4. Rowing boats, whether under oars or sails, shall have ready at hand a lantern showing a white light which shall be temporarily exhibited in sufficient time to prevent collision.

The vessels referred to in this Article shall not be obliged to carry the lights prescribed in Article 4 (*a*), and Article 11, last paragraph.

Art. 8. Pilot-vessels, when engaged on their station on pilotage duty, shall not show the lights required for other vessels but shall carry a white light at the mast-head, and also exhibit a flare-up light or flare-up lights at short intervals, which shall never exceed 15 minutes.

On the near approach of or to other vessels they shall have their side-lights lighted, ready for use, and shall flash or show them at short intervals, to indicate the direction in which they are heading, but the green light shall not be shown on the port side nor the red on the starboard.

A pilot vessel of such a class as to be obliged to go alongside of a vessel to put a pilot on board, may show the white light instead of carrying it at the mast-head, and may, instead of the coloured lights above mentioned, have at hand ready for use, a lantern with a green glass on the one side and a red glass on the other, to be used as prescribed above.

Pilot-vessels, when not engaged on their station on pilotage duty, shall carry lights similar to those of other vessels of their tonnage.

Art. 9.*Open Boats and Fishing Vessels of less than 20 tons net registered tonnage, when under weigh and when not having their nets, trawls, dredges, or lines in the water, shall not be obliged to carry the coloured side-lights ; but every such boat and vessel shall in lieu thereof have ready at hand a lantern with a green glass on the one side, and a red glass on the other side, and on approaching to or being approached by another vessel, such lantern shall be exhibited in sufficient time to prevent collision, so that the green light shall not be seen on the port side, nor the red light on the starboard side.

*This Article will be revised at a future date

The following portion of this Article applies only to Fishing vessels and boats when in the sea off the coast of Europe lying North of Cape Finisterre :—

(*a*) All Fishing Vessels and Fishing Boats of 20 tons net registered tonnage or upwards, whether Steam or Sailing Vessels, when under weigh and when not required by the following Regulations to carry and show the lights therein named, shall carry and show the same lights as other Vessels under way.

(*b*) All vessels when engaged in fishing with drift nets shall exhibit two white lights from any part of the vessel where they can be best seen. Such lights to be placed so that the vertical distance between them shall be not less than 6 feet, and not more than 10 feet ; and so that the horizontal distance between them measured in a line with the keel of the vessel shall be not less than 5 feet and not more than 10 feet. The lower of these two lights to be more forward, and both of them to be of such a character, and contained in lanterns of such construction, as to show all round the horizon on a dark night with a clear atmosphere, for a distance of not less than three miles.

(*c*) A Vessel employed in line fishing with her lines out shall carry the same lights as a Vessel when engaged in fishing with drift nets.

(*d*) If a Vessel when fishing becomes stationary in consequence of her gear getting fast to a rock or other obstruction, she show the light and make the fog signal for a Vessel at anchor.

(*e*) Fishing Vessels and open boats may at any time use a flare-up in addition to the lights which they are required by this Article to carry and show. All flare-up lights exhibited

by a Vessel when trawling, dredging, or fishing with any kind of drag-net, shall be shown at the after part of the Vessel, excepting that if the Vessel is hanging by the stern to her trawl, dredge, or drag-net, they shall be exhibited from the bow.

(*f*) Every Fishing Vessel and every open boat when at anchor between sunset and sunrise shall exhibit a white light visible all around the horizon at a distance of at least one mile.

(*g*) In fog, mist, or falling snow, a drift-net Vessel attached to her nets and a vessel when trawling, dredging, or fishing with any kind of drag-net, and a Vessel employed in line fishing with her lines out, shall at intervals of not more than two minutes make a blast with her fog-horn and ring her bell alternately.

(*h*) Steam Vessels engaged in trawling when under steam, if of 20 tons gross registered tonnage or upwards, and having their trawls in the water and not being stationary in consequence of their gear getting fast to a rock or other obstruction, shall, between sunset and sunrise, either carry and show the lights required by Article 2, or shall carry and show in lieu thereof and in substitution therefor, but not in addition thereto, other lights of the following description, viz. :—

On or in front of the foremast head and in the same position as the white light which other Steam Ships are required to carry, a lantern showing a white light ahead, a green light on the starboard side, and a red light on the port side, such lantern to be so constructed, fitted and arranged, as to show an uniform and unbroken white light over an arc of the horizon of four points of the compass, an uniform and unbroken green light over an arc of the horizon of 10 points of the compass,

and an uniform and unbroken red light over an arc of the horizon of 10 points of the compass, and to be so fixed as to show the white light from right ahead to two points on the bow on each side of the Ship, the green light from two points on the starboard bow to four points abaft the beam on the starboard side, and the red light from two points on the port bow to four points abaft the beam on the port side; and in addition a white light in a globular lantern of not less than 8 inches in diameter, and so constructed as to show a clear, uniform and unbroken light all round the horizon, the lantern containing such white light to be carried lower than the lantern showing the green, white, and red lights as aforesaid; so, however, that the vertical distance between them shall not be less than 6 feet nor more than 12 feet.

The said green, white, and red lights to be of such a character as to be visible at a distance of not less than two miles on a dark night with a clear atmosphere.

Sailing Vessels engaged in trawling if of 20 tons registered tonnage or upwards, and having their trawls in the water, and not being stationary in consequence of their gear getting fast to a rock or other obstruction, shall, between sunset and sunrise, carry and show, one, and one only, of the following three systems of lights.

Either:—

1. The lights required by Article 5.

Or:—

2. On or in front of the foremast head a lantern having a green glass on the starboard side, and a red glass on the port side, so constructed, fitted, and arranged, that the red

and green do not converge, but show an uniform and unbroken green light over an arc of the horizon of 12 points of the compass, and an uniform and unbroken red light over an arc of the horizon of 12 points of the compass; the lantern to be also so fixed as to show the green light from right ahead to four points abaft the beam on the starboard side, and the red light from right ahead to four points abaft the beam on the port side; and in addition a white light in a globular lantern of not less than eight inches in diameter, and so constructed as to show a clear, uniform, and unbroken light all round the horizon; the lantern containing such white light to be carried lower than the lantern showing the green and red lights as aforesaid, so however that the vertical distance between them shall not be less than 6 feet, and not more than 12 feet.

The said red and green lights shall be of such a character as to be visible at a distance of not less than two miles on a dark night, with a clear atmosphere.

Or :—

3. The following, which may also be carried and shown by fishing vessels of less than 20 tons net registered tonnage engaged in trawling with their trawls down :—

A white light in a globular lantern of not less than 8 inches in diameter, and so constructed as to show a clear, uniform, and unbroken light all round the horizon, and visible on a dark night with a clear atmosphere, for a distance of at least two miles; and also a sufficient supply of red pyrotechnic lights which shall each burn for at least 30 seconds; and, when so burning, shall be visible for the same distance under

the same conditions as the white light. The white light to be shown from sunset to sunrise, and one of the red pyrotechnic lights to be shown on approaching or on being approached by, another ship or vessel in sufficient time to prevent collision.

Note.—The foregoing Rules contained in clause (*h*) do not apply to the fishing vessels and boats of any Foreign Country until further Orders.

Art. 10. A vessel which is being overtaken by another shall show from her stern to such last-mentioned vessel a white light or a flare-up light.

The white light required to be shown by this Article may be fixed and carried in a lantern, but in such case the lantern shall be so constructed, fitted and screened, that it shall throw an unbroken light over an arc of the horizon of 12 points of the compass, viz., for 6 points from right aft on each side of the vessel, so as to be visible at a distance of at least 1 mile. Such light shall be carried as nearly as practicable on the same level as the side lights.

Art. 11. A vessel under 150 feet in length, when at anchor, shall carry forward, where it can best be seen, but at a height not exceeding 20 feet above the hull, a white light in a lantern so constructed as to show a clear, uniform and unbroken light, visible all round the horizon at a distance of at least one mile.

A vessel of 150 feet or upwards in length, when at anchor, shall carry in the forward part of the vessel, at a height of not less than 20 and not exceeding 40 feet above the hull,

one such light, and at or near the stern of the vessel, and at such a height that it shall be not less than 15 feet lower than than the forward light, another such light.

The length of a vessel shall be deemed to be the length appearing in her certificate of registry.

A vessel aground in, or near a fairway shall carry the above light or lights and the two red lights prescribed by Article 4 (*a*).

Art. 12. Every vessel may, if necessary in order to attract attention, in addition to the lights which she is by these Rules required to carry, show a flare-up light or use any detonating signal that cannot be mistaken for a distress signal.

Art. 13. Nothing in these Rules shall interfere with the operation of any special rules made by the Government of any nation, with respect to additional station and signal-lights for two or more ships of war or for vessels sailing under convoy, or with the exhibition of recognition signals adopted by shipowners, which have been authorized by their respective Governments, and duly registered and published.

Art. 14. A steam-vessel proceeding under sail only, but having her funnel up, shall carry in day-time forward, where it can best be seen, one black ball or shape 2 feet in diameter.

Sound-signals for Fog, &c.

Art. 15. All signals prescribed by this Article for vessels under way shall be given :—

1. By "steam-vessels" on the whistle or siren.

2. By "sailing-vessels and vessel towed" on the fog-horn.

The words "prolonged blast" used in this Article shall mean a blast of from 4 to 6 seconds duration.

A steam-vessel shall be provided with an efficient whistle or siren, sounded by steam or some substitute for steam, so placed that the sound may not be intercepted by any obstruction, and with an efficient fog-horn, to be sounded by mechanical means, and also with an efficient bell.* A sailing-vessel of 20 tons gross tonnage or upwards shall be provided with a similar fog-horn and bell.

In fog, mist, falling snow, or heavy rainstorms, whether by day or night, the signals described in this Article shall be used as follows, viz. :—

(*a*) A steam-vessel having way upon her shall sound, at intervals of not more than 2 minutes, a prolonged blast.

(*b*) A steam-vessel under way, but stopped and having no way upon her, shall sound, at intervals of not more than 2 minutes, two prolonged blasts, with an interval of about 1 second between them.

(*c*) A sailing-vessel under way shall sound at intervals of not more than 1 minute, when on the starboard tack one blast, when on the port tack two blasts in succession, and when with the wind abaft the beam three blasts in succession.

(*d*) A vessel, when at anchor shall, at intervals of not more than 1 minute, ring the bell rapidly for about 5 seconds.

(*e*) A vessel when towing, a vessel employed in laying or in picking up a telegraph cable, and a vessel under way which is unable to get out of the way of an approaching vessel

* In all cases where the Rules require a bell to be used a drum may be substituted on board Turkish vessels, or a gong where such articles are used on board small sea-going vessels.

through being not under command, or unable to manœuvre as required by these Rules, shall, instead of the signals prescribed in sub-divisions (*a*) and (*c*) of this Article, at intervals of not more than 2 minutes, sound three blasts in succession, viz., :— one prolonged blast followed by two short blasts. A vessel towed may give this signal, and she shall not give any other.

Sailing vessels and boats of less than 20 tons gross tonnage shall not be obliged to give the above-mentioned signals, but if they do not, they shall make some other efficient sound-signal at intervals of not more than 1 minute.

Speed of Ships to be Moderate in Fog, &c.

Art. 16. Every vessel shall, in a fog, mist, or falling snow, or heavy rain-storms, go at a moderate speed, having careful regard to the existing circumstances and conditions.

A steam-vessel hearing, apparently forward of her beam, the fog-signal of a vessel the position of which is not ascertained shall, so far as the circumstances of the case admit, stop her engines, and then navigate with caution, until danger of collision is over.

Steering and Sailing Rules.

Preliminary—Risk of Collision.

Risk of collision can, when circumstances permit, be ascertained by carefully watching the compass bearing of an approaching vessel. If the bearing does not appreciably change, such risk should be deemed to exist.

Art. 17. When two sailing-vessels are approaching one another so as to involve risk of collision, one of them shall keep out of the way of the other, as follows, viz., :—

(*a*) A vessel which is running free shall keep out of the way of a vessel which is close-hauled.

(*b*) A vessel which is close-hauled on the port tack shall keep out of a vessel which is close-hauled on the starboard tack.

(*c*) When both are running free, with the wind on different sides, the vessel which has the wind on the port side shall keep out of the way of the other.

(*d*) When both are running free, with the wind on the same side, the vessel which is to windward shall keep out of the way of the vessel which is to leeward.

(*e*) A vessel which has the wind aft shall keep out of the way of the other vessel.

Art. 18. When two steam-vessels are meeting end on, or nearly end on, so as to involve risk of collision, each shall alter her course to starboard, so that each may pass on the port side of the other.

This Article only applies to cases where vessels are meeting end on, or nearly end on, in such a manner as to involve risk of collision, and does not apply to two vessels which must, if both keep on their respective courses, pass clear of each other.

The only cases to which it does apply are, when each of the two vessels is end on, or nearly end on, to the other; in other words, to cases in which, by day, each vessel sees the

masts of the other in a line or nearly in a line with her own and by night, to cases in which each vessel is in such a position as to see both side-lights of the other.

It does not apply, by day to cases in which a vessel sees another ahead crossing her own course; or by night, to cases where the red light of one vessel is opposed to the red light of the other, or where the green light of one vessel is opposed to the green light of the other, or where a red light without a green light, or a green light without a red light, is seen ahead or where both green and red lights are seen anywhere but ahead.

Art. 19. When two steam vessels are crossing, so as to involve risk of collision, the vessel which has the other on her own starboard side shall keep out of the way of the other.

Art. 20. When a steam-vessel and a sailing-vessel are proceeding in such direction as to involve risk of collision the steam-vessel shall keep out of the way of the sailing-vessel.

Art. 21. Where by any of these Rules, one of two vessels is to keep out of the way, the other shall keep her course and speed.

NOTE.—When, in consequence of thick weather or other causes, such vessel finds herself so close that collision cannot be avoided by the action of the giving-way vessel alone, she also shall take such action as will best aid to avert collision, (See Articles 27 and 29).

Art. 22. Every vessel which is directed by these Rules, to keep out of the way of another vessel, shall, if the circumstances of the case admit, avoid crossing ahead of the other.

Art. 23. Every steam-vessel which is directed by these Rules, to keep out of the way of another vessel shall, on approaching her, if necessary, slacken her speed or stop or reverse.

Art. 24. Notwithstanding anything contained in these Rules, every vessel overtaking any other, shall keep out of the way of the overtaken vessel.

Every vessel coming up with another vessel from any direction more than 2 points abaft her beam, i.e., in such a position, with reference to the vessel which she is overtaking, that at night she would be unable to see either of that vessel's side lights, shall be deemed to be an overtaking vessel ; and no subsequent alteration of the bearing between the two vessels shall make the overtaking vessel a crossing vessel within the meaning of these Rules, or relieve her of the duty of keeping clear of the overtaken vessel until she is finally past and clear.

As by day the overtaking vessel cannot always know with certainty whether she is forward of or abaft this direction from the other vessel, she should, if in doubt, assume that she is an overtaking vessel and keep out of the way.

Art. 25. In narrow channels every steam-vessel shall, when it is safe and practicable, keep to that side of the fair-way or mid-channel which lies on the starboad side of such vessel.

Art. 26. Sailing-vessels under way shall keep out of the way of sailing vessels or boats fishing with nets, or lines, or trawls. This Rule shall not give to any vessel or boat engaged in fishing, the right of obstructing a fair-way used by vessels other than fishing-vessels or boats.

Art. 27. In obeying and construing these Rules due regard shall be had to all dangers of navigation and collision, and to any special circumstances which may render a departure from the above Rules necessary in order to avoid immediate danger.

SOUND-SIGNALS FOR VESSELS IN SIGHT OF ONE ANOTHER.

Art. 28. The word "short blasts" used in this article, shall mean a blast of about one second's duration.

When vessels are in sight of one another, a steam-vessel under way, in taking any course authorised or required by these Rules, shall indicate that course by the following signals on her whistle or siren, viz :—

One short blast to mean. "I am directing my course to starboard."

Two short blasts to mean, "I am directing my course to port."

Three short blasts to mean, "My engines are going full speed astern."

NO VESSEL UNDER ANY CIRCUMSTANCES, TO NEGLECT PROPER PRECAUTIONS.

Art. 29. Nothing in these Rules shall exonerate any vessel or the owner, or master, or crew thereof, from the consequences of any neglect to carry lights or signals, or of any neglect to keep a proper look-out or of the neglect of any precaution which may be required by the ordinary practice of seamen, or by the special circumstances of the case.

Reservation of Rules for Harbours and Inland Navigation.

Art. 30. Nothing in these Rules shall interfere with the operation of a special rule, duly made by local authority, relative to the navigation of any harbour, river, or inland waters.

Distress Signals.

Art. 31. When a vessel is in distress and requires assistance from other vessels or from the shore, the following shall be the Signals to be used or displayed by her, either together or separately; viz.:—

In the daytime—

1. A gun or other explosive signal fired at intervals of about a minute;

2. The International Code Signal of distress indicated by N. C.;

3. The distant signal, consisting of a square flag, having either above or below it a ball or anything resembling a ball;

4. A continuous sounding with any fog-signal apparatus.

At night—

1. A gun or other explosive signal fired at intervals of about a minute;

2. Flames on the vessel (as from a burning tar-barrel, oil-barrel, &c.);

3. Rockets or shells, throwing stars of any colour or description, fired one at a time, at short intervals;

4. A continuous sounding with any fog-signal apparatus.

245. The following lines by Mr. Gray, will be found useful as an aid to memory.

Meeting steamers do not dread
When you see three lights ahead:
Port your helm and show your red.

Green to green, or red to red;
Perfect safety, go ahead.

If to starboard red appear
'Tis your duty to keep clear;
To act as judgment says is proper,
Port, or Starboard, Back, or Stop her.

But when upon your port is seen
A steamer's starboard light of green,
There's not so much for you to do;
For green to port keeps clear of you.

Both in safety and in doubt,
Always keep a good look out;
In danger with no room to turn,
Ease her, stop her, go astern.

246. Close hauled on opposite tacks.—The ship on the port tack is always to give way, if necessary, either by keeping away, or going about.

247.—Ships with the wind free.—Give way to those on a wind; therefore, the ship on the port tack stands on.

248. Two ships having the wind large.—As both ships are running free with the wind on different sides, the ship which has the wind on the port side has to keep out of the way of the other, hence the ship to the westward gives way.

249. UNDER STEAM.—And *nearly* end on to each other both port their helms and pass on the port side.

250. A STEAMER.—Always gives way to a sailing vessel, and it must be remembered that every vessel under sail, with steam ready, though not using it, is considered a steamer in the event of a collision.

251. EVERY VESSEL UNDERWEIGH—Is to carry a green light on the starboard, and a red light on the port side; steamers in addition carry a white light at the foremost head. The side lights to be fitted with inboard screens, projecting at least 3 feet forward from the light, so as to prevent the light from being seen across the bow. Vessels towing, carry two white mast-head lights.

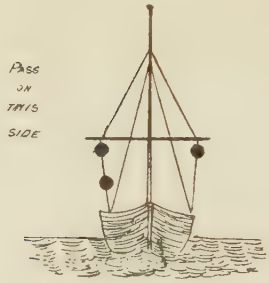
252. DURING FOGS.—Vessels under steam are to sound a steam whistle; vessels under sail to use a fog horn; at anchor, ring a bell.

These signals to be sounded at intervals of not more than two minutes.

253. BUOYING AND MARKING WRECKS.—Wreck buoys are coloured green with the word WRECK painted in white letters on them.

When possible, the buoy is placed near the side of the wreck next to mid-channel.

When a wreck-marking vessel is used its top sides are painted green, with the word WRECK in white letters on it and exhibits—



By Day :—Three balls on a yard, 20 feet above the sea ; two placed vertically on the side that shipping may safely pass, and one on the other side.

By Night :—Three FIXED white lights, similarly arranged, are shown but not the ordinary riding light.

In narrow waters, or in rivers, harbours, &c., under the jurisdiction of local authorities, the same rules may be adopted or at discretion varied as follows.

When a wreck-marking vessel is used she is to carry a cross yard on a mast with 2 balls by day placed horizontally not less than 6 feet nor more than 12 feet apart, and two lights by night similarly placed. When a barge or open boat only is used a flag or ball is to be shown in the day time.

254. Light vessel driven from her moorings :—Makes the following signals, viz, the usual lights are not exhibited but a fixed red light is shown at each end of the vessel, and a red flare shown every quarter of an hour.

By Day :—The balls or other distinguishing marks are struck.

N.B.—1. If from any cause a light vessel is unable to show her usual lights whilst at her station, the riding light only is shown.

N.B.—2. Light vessels are usually painted red as they are more visible in a fog than they would be if painted any other colour.

Chapter X.

FITTING OUT, MAKING AND SHORTENING SAIL, GEAR CARRIED AWAY, SHIFTING SAILS AND SPARS, LAWS OF STORMS, &c.

255. Chafing Gear.—Paunch mats on the bunt of all yards between the yard and masts, well greased. A mat on the quarters of the topsail-yards in wake of the rigging. Breeches mats on the collars of lower stays (but here and elsewhere, bamboo scotchmen are preferable, when they can be obtained). A mat on lower yards to protect the sail where it takes the stay, when braced up. A mat under each leech-line block ; hanging mats (or a hide) on the lower rigging, where the yards bind ; on topmast backstays, for the same purpose, and in the wake of staysail pendants ; on foremost swifter of lower rigging where the foot of the courses takes, and on the lanyards where the sheet chafes ; on cross-jack yard-arms, for the preservation of the spanker ; and on the horns of the crosstrees, for the protection of the top-gallant sails. Battens should be permanently fitted on the sheet-anchor stocks, to prevent the hoops cutting the fore sheets ; or a mat should be laced on.

An Account of the Fitting out of H.M.S. "Bellerophon," This affords a brilliant example of what *can* be done in the Navy, when a ship's company is commanded by officers possessing the requisite union of due seamanlike and admin-

istrative qualities, and I give it as a high standard by which all such work may be measured, and as an appropriate pendant to the first section of our subject.

On March 7th, 1847, orders were unexpectedly received for the 90-gun ships "Rodney," Captain Edward Collier, C.B., and "Albion," Captain Nicholas Lockyer, C.B., to fit out respectively, the "Bellerophon," 78, and the "Calcutta," 84, then lying up in ordinary, the former in Portsmouth, and the latter in Plymouth harbour.

These ships, in common with all the "advanced" ships in ordinary, had their lower masts, gun-carriages, chain cables (in 12-fathom lengths), stowed in their tiers, and the lower tier of water-tanks on board; which state the "Bellerophon," was in when the "Rodneys" *commenced* work on Monday morning, March 9th. On the same evening the topmasts were fidded, and mizen top-gallant mast pointed. By Tuesday evening the top-gallant-masts were fidded, running gear rove, and sails bent. At half-past ten on Wednesday morning she hauled off from the jetty, and that evening saw her at Spithead with three month's provisions and stores on board, awaiting orders to proceed to sea.

The ship's company went ashore every evening, and had their full time for meals every day; and thus a line-of-battle ship was fitted out for a three months' cruise, in every way ready to engage an enemy, in thirty working hours.

H.R.H. Prince Albert having visited the ship, and expressed his admiration of the skill and energy exhibited in the accomplishment of so unexampled a result, she was dismantled and returned again into ordinary.

256. In Steam Launch.—Get her alongside, and with the watch hoist out the engine; and, if necessary, the coal boxes and water tanks. The engine is slung with chain slings, having four legs to it, and is hoisted in with the main-yard and stay tackles. Then "hands in launch;" *top-gallant yard-men and topsail sheetmen* "away aloft" coming in the starboard side—"starboard lifts"—"top away," at once, and haul taut the topsail sheets, "Belay the lifts"—"lay out." Two burtons are hooked to each lower yard; haul taut and frap the burtons, lifts, and topsail sheets, together with a small line from the top. "Trice up, brace in," on which the stays are triced up; yard tackles lowered and the yards braced, so as to plumb the boat as much as possible, while still allowing her to clear the ship's side; braces and trusses hauled well taut.

"Lay in," "down from aloft"—hook the yard and stay-tackles; "haul taut the yards;" away with the yards taking down the slack of the stays. When high enough, "turn with yards," "away with the stays" Heave a line out of the boat for a luff to bring her into place, and a fore and after forward to steady her, "Turn with the stays;" "man the rigging;" "lower of all" "away aloft." Let go the burtons topsail-sheets and rolling tackles; top away on the port lifts and get the squaring marks down at once. Then, "trice to hand"—"lay out." Unhook the stays, man the braces and bill and quarter tricing lines; "hold fast on the lower yards;" then "lower and square." "Square yards," and "down from aloft." When another boat has to follow, hook the stays to the slings, and the yards to the stays, the yards can then be unhooked and passed over again, whilst the first boat is being placed.

257. Ship Rolling Heavily.—The great thing to look out for is to keep the boat from being stove, while hoisting; therefore, take a whip to the bows of the boat, from the lower boom end. Run the guns in, lower the ports, be prepared to fend her off well. When well up to the nettings, hook the opposite stays crossed, and use bow and stern guys, from both sides of the deck.

258. You top up first—Because, otherwise, the lifts and burtons would bind against the topmast rigging, on pulling up.

259. Making Plain Sail.—"Clear lower deck;" "make all plain sail, starboard tack;" "upper yardmen aloft;" man the topsail sheets and halyards; "away aloft;" "trice up, lay out;" "hoist the jib;" "let fall, sheet home;" upper sails to be kept up until the topsails are nearly mast-headed; then let fall by order, sheeted home and hoisted.

As each sail is let fall, the loosers should lay in, and move smartly down from aloft.

"Port braces"—"fore and main tacks;" "brace forward;" "let run, haul on board"—when the sails are set, and yards braced up; "haul taut weather braces, lifts, and trusses;" coil down ropes.

260. Tacking.—Keep the ship full for stays, and give the word "Ready, O!" to enforce attention. *Ease* the helm down, that her way may not be too suddenly checked. Haul over the boom; and, when the helm is down, "Helm's a-lee!" on which the fore and head sheets are let go and over-hauled. When the wind is out of the mainsail, "Raise tacks and sheets," keeping the fore tack fast till the main yard is

hauled, for as the foresail bellies in to the mast (which she always does to a certain extent when the fore tack is let go) it becomes a back sail, and retards the ship in coming to. This is still more the case when, in a strong breeze, it becomes necessary to check the fore bowline, to relieve it of the undue strain brought upon it. The top-gallant bowlines at the same time let go, the lee main tack shortened in the weather after (preventer) braces, and lee maintop bowline manned; and when the wind is ahead, as a general rule, or in quick working ships, a little before, taking the main topsail as your guide,—the weather leech of which will be well aback or, in a dark night judging by the shaking of the spanker—"Haul well taut; mainsail haul!" The after yards are swung and braced up as far as the fore yard will allow—the lee head braces, in short ships, being checked for that purpose, the maintop bowline run away with, and a turn taken before the main-yard can fly back again, main tack boarded and sheet gathered aft, head sheet shifted over, and boom sheet eased off. When all safe, and the after sails begin to fill, the head bowlines are let go, the head yards braced round, and the fore tack boarded, to the order "Fore tack, head bowlines—Of all haul;" if however, she has paid off too rapidly, the head yards should not be braced up till she has come to, or is coming to the wind. The main yard is now braced up, and the sheet hauled aft. The helm is righted if she loses her way, and shifted over if she gathers sternway. The lee breast backstays, when used, are borne abaft, and the weather one crutched and pulled up in stays. Finally, the yards are all trimmed, the weather braces hauled taut, the weather lifts bowsed up, and the bowlines hauled. When done, pipe the sweepers, call the hammock stowers

and coil down ropes—every man a rope, and every rope on end.

261. Top-Gallant Bowlines—Are let go, when you raise tacks and sheets, because, when the sails are aback, if the lee braces are not quite taut, the whole strain of the top-gallant sail, and great part of that of the topsail would come upon them ; and, also, that they may be cleared away in good time before the yards are hauled.

262. The Lee Fore Tack—Is not shortened in like the lee main tack, because, by doing so, you would make a back sail of it, and prevent the ship coming to.

263. Tacking in Light Winds.—Keep away a little, and get as much way on as possible, before putting the helm down.

Man the head sail downhauls ; ease the helm down ; check the lee head braces, and head bowlines.

" Helm's a-lee ;" haul down the head sails ; brace the head yards up as she comes to the wind ; when nearly head to the wind, brace round the yards on the mizen mast ; and when the wind is fairly round on the other bow, haul the main yard, and hoist the head sails.

264. Missing Stays.—On port tack.—Haul aft the head sheets, put the helm a-starboard, raise the main clewgarnets, brail up the spanker, and square the after yards. Then, when she fills, either brace up again on the port tack, and try it again ; or let her come round on her heel, squaring the head yards when the wind comes aft, shifting the helm as she gathers way, and bringing her to the wind on the starboard tack.

265. Danger on the Lee Beam.—Run the weather braces in, and make a stern-board till clear.

266. Tacking in a Breeze.—Ease away the weather head braces with a turn, keeping a strain on them when the yards fill, and standing by to belay in time; for, if let go and overhauled, as in moderate weather, a sprung yard would be the possible consequence.

267. The Larger Helm—Carried in the freshening breeze, is occasioned by the increased immersion of the bow which throws her up into the wind; and, owing to the oblique direction given to the rudder as the ship heels over, much of the effect is lost, and a greater helm is required in consequence.

268. About Ship, Up Mainsail.—Instead of "raise tacks and sheets;" it will be, "raise the fore-tack;" "up mainsail" and "maintopsail haul;" instead of "mainsail haul."

269. The Distance gained to Windward.—When lying within $5\frac{1}{2}$ points of the wind, is 47 per cent. on the whole distance run; as you will see by reference to a transverse table.

270. The Action of the Rudder.—Causes a ship to rotate on an axis before the centre; the exact position of which depends upon the build and rig of the ship. A Chinese cargo-boat will fly round with the bow almost stationary.

271. A Ship heels over—At first from the sudden action of the wind upon the sails; and she rights as she gathers away, from the increased lifting pressure of the water on the lee side.

272. To FORE-REACH IN STAYS.—Ease the helm down very gradually, haul the main yard the moment you can insure her staying, and, in a fresh breeze, keep fast the fore sheet if the ship works well.

273. To AVOID FORE-REACHING.—Round to quickly, check the lee head-braces, and make a late haul of the main yard.

274. STEAM AND SAIL.—Tacking with the watch, look out and haul the after yards quickly, or you will have a bother with both them and the head yards if she gets on the other tack before you.

275. To WINDWARD.—Your companion is the weathermost, for a line drawn from her at right angles to the wind will fall to windward of you.

276. TAKEN ABACK.—As she will lie her course on the other tack, pipe "Watch about ship;" raise tacks and sheets, brace round the after yards, board the main tack attend to the helm, and haul the head yards as in tacking.

Should she refuse to come to starboard, and has lost her way, port the helm, up mainsail, in spanker, square the after yards, and wear round.

When taken aback with the wind on the lee bow, there is, of course, no help for it but to go round; but if the wind is ahead or on the weather bow, and you do not wish to go on the other tack, you box her off with the head yards; that is if flattening in, easing the boom over, &c., are not sufficient.

277. Wearing under Plain Sail.—Up mainsail and in spanker: put the helm up, "let go the bowlines—round in the after yards; keep bracing in as her head pays off, shivering the mizen topsail, but keeping the main just lifting. When the wind is aft, "raise the fore tack"—"square the head yards." Brace forward the after yards and bring her to the wind; haul out the spanker, brace up, set the mainsail, and haul aft the head sheets. It is a good plan, particularly if wearing with the watch and using steam, to brace the head yards right up on the new tack, after squaring them, before manning the after braces.

278. Wearing short round.—Starboard tack before going round. Throw the ship up in the wind to deaden her way; haul up the mainsail, and brail up the spanker; brace the head yards a-box, and square the after yards; put the helm a-port when she gathers stern-way, amidships when she loses it, and a-starboard when the after sails fill and she gathers headway. Square the head yards as in wearing, and when you have brought the wind on the port quarter, brace up the after yards, haul out the spanker, and board the main tack.

279. Wearing in a Gale.—With a heavy sea running, requires great care, and a temporary lull in the weather should if possible be taken advantage of. Trusses, preventer braces rolling, and relieving tackles, must be carefully attended, plenty of way should be kept on the ship, that the helm may be well answered.

280. Wear in a storm when all other means have failed.—By manning the fore rigging as thickly as the

men can pack, ships, under the circumstances stated in the question, have wore when all previous attempts were unsuccessful.

But a sea-anchor, or stop water, with a hawser from the quarter, will do better if you can launch it.

281. SHIFTING OVER STORM STAYSAIL-SHEETS.—The general plan, and I think the best, is to haul down the sail, shift over the sheet, steady aft and hoist, but it may be done by using luffs as sheets from the opposite sides.

282. WEARING UNDER STAYSAILS.—Put the helm up, brail up the after trysails, and turn the yards as with sail set. In a very heavy sea it may be necessary to drop the reefed foresail for the purpose of keeping way on the ship, and preventing her being pooped, even at the risk of not being able to furl it again. In the mean time shift the sheets over and steady them aft; when before the wind set the after sails and haul down the fore and main staysails, setting them again as soon as the sheets are shifted over.

283. SETTING STUDDING-SAILS.—"Hands trim and make sail—studding sails both sides" "Away aloft." "Main clew-garnets and buntlines, spanker brails," "Up mainsail brail up." "Weather braces, lifts and trusses. Raise the fore tack, round in." When ready with the studding-sails, "Boom topping-lifts, fore guys, topmast and top-gallant studding-sail halyards." "Haul taut." "Rig out, trice to hand." On which the lower booms are topped up, and hauled forward, top-mast and top-gallant studding-sail booms rigged out, topmast and top-gallant studding-sails triced up to the yards, head stops cut, sails launched over the brace blocks, and the slack of the tacks taken down. The lower

halyards are then manned by the hands from the topping-lifts and fore guys, and at the word "Hoist away," every thing goes out together.

Otherwise, "Boom-jiggers, topmast and top-gallant studding-sail halyards." "Rig out, hoist away." The sails are then set as quickly as possible independent of each other: and when set, and the lower studding-sails ready, "Boom topping-lifts, fore guys, lower halyards." "Top up, hoist away."

284 TAKING IN STUDDING-SAILS.—"Hands shorten sail —studding-sail downhauls." "Away aloft." "Top up the lower booms." Lower studding-sail tripping lines, topmast and top-gallant studding-sail downhauls, boom jiggers and after guys manned; then "Haul taut, trip up the lower studding-sail, shorten sail."

It may not be out of place here to make a few remarks upon the fitment of studding-sail gear.

Lower studding-sail tripping-lines are best rove from aft (commencing at the clew), through an eyelet-hole in the centre of the sail, and up before all through the block on the inner yard-arm.

Lower studding-sail yards, half the usual length, make the sail much easier to handle.

A long lizard for the lower boom topping-lift, rove through a block at the fore yard-arm, through block at the slings, and thence on deck, is preferable to the usual lizard taken out by hand.

Lizards, both for topmast and lower studding-sails are an improvement on rope-yarn stops. For this purpose a

strop, with a thimble seized in, should be fitted to the outer arm of the topmast studding-sail yard, and the lizard spliced close outside it, round the yard. After the sail is rolled up, a turn is taken round the sail and halyards, and through the thimble, passed along the sail to the bunt, and hitched round the sail; the bight being jambed between its own part and the sail, so that when hauled upon, or a turn taken round the lower lift and the halyards hoisted on, it comes adrift. For the lower studding-sail, a strop attached to the lizard is merely put round the sail; a toggle, into which the lizard is spliced, put through the bight, a turn taken on the forecastle when high enough, and the sail hoisted.

An enlarged topmast studding-sail may be set by means of a jack yard laced to the outer part of the foot, the tack bent to the centre; and a fore topmast studding-sail tack may with advantage be kept rove through a tail-block in the bunt of the fore yard, where, practically, whatever it may do in theory, it requires no attention when trimming sails; and abaft, there is only one rope, the boom-brace, to attend, instead of two.

Instead of taking a burton out on the topsail yard, let a pendant be fitted, rove through the span block (double), at the mast-head, with a hook on one end to take out on the yard, and a thimble at the other to hook the burton to, the single block of which is hooked to a strop round the eyes of the lower rigging.

Let the topmast studding-sail downhauls be led through a tail-block on the topsail-sheet or some convenient place; which slip directly the yard comes down to it, running away

with the downhaul, and bringing the sail in without a check. The deck sheet should be rove through a leading block.

Have top-gallant studding-sail downhauls bent to the inner yard-arm, and rove through a thimble in the inner leech.

285. After setting a Topmast Studding-sail.—Steady taut the deck sheet, get hold of the short sheet, reeve it through a tail-block on the quarter iron, bend it to a rope's-end out of the top, haul it up, haul aft and belay it; *then* come up the deck sheet, bend it to the downhaul, and pay them down before all; afterwards, shift the boom jigger for rigging in,—or, instead of shifting it, overhaul the hauling part, hitch it to the heel of the boom, and rig in with the single part.

286. After taking in a Topmast Studding-Sail.—Unbend the tack and halyards, and bend them together; swing the halyards in to the hands on the yard, who haul them up, dip them abaft, and pay them down, when they are again bent ready for setting; take the burton off the topsail yard, and shift the boom jigger for rigging out.

287. Flying Lower Studding-sail—Take the sail in and run a few eyelet-holes along the foot a short distance in from the outer clew. Lace it to a jack yard (a small studding-sail, or boat's yard will do), fitted with a span; and, as the outer leg should be somewhat longer than the inner one, put a seizing round both parts. Bend the tack to the bight, and set the sail again. A deep sea lead on the clew will imperfectly answer the same purpose.

288. Fore Topmast Studding-boom unclamped.—Round down on the lower halyards, put a knot in them, pull

up and lift the boom, leaving end enough below the knot to round down again.

289. Heel Lashings.—That of a topmast studding-boom is secured round the quarter iron ; of a top-gallant studding-boom, through the quarter strop and round the jackstay.

290. The Advantage of a Studding-sail bend.—Is that it lies close to the yard, and consequently permits of little or no drift between the yard and block.

A strop to go two thirds round the yard—a small iron toggle spliced into the end of the halyards—the halyards rove through the bights of the strop, and toggled—is equally secure, equally neat, and far more convenient for bending and unbending, which you must do every time you take in the sail.

291. Dipping a Topmast Studding-sail Before-all.—Send a couple of hands on the lower yard : lower the sail well down, and let them gather it in until they get hold of the outer leech which is then gathered down, until the inner yard-arm can be canted before the leech of the topsail, then let go and hoist away,

It should be remembered that a touch of the helm may help a good deal in setting and taking in studding-sails.

292. Dipping a Topmast Studding sail Abaft-all.—Gather down on the *inner* leech.

293. Hitch with the Downhaul round the clew.—Let the boom come in, gather in on the foot, lay hold of the clew, and then clear the downhaul.

294. Gear Tricing-line.—The lower studding-sail tripping-line is used, bent to a strop and toggle. The

studding-sail gear should be kept aft, stopped along the waist ridge ropes, and merely triced up, instead of being stopped along the fore yard.

295. Setting Studding-sails—*With a swell on*, without much wind to steady the sails, haul taut the buntlines and bowlines before laying out on the yards.

296. Reefing Topsails—Topmast studding-sail set; lower the topsail *when the burton or preventer lift is off the yard*, the studding-sail being in.

297. Coming to the Wind.—Take in the royals, and one or two reefs; the jib, and a reef in the spanker if necessary. While reefing, bring the ship to the wind under the courses.

298. Getting Sheets Home.—Always get the lee sheet home first; then ask the officer of the watch, if necessary, to give her a luff up, and get the weather sheet home while the sail is lifting.

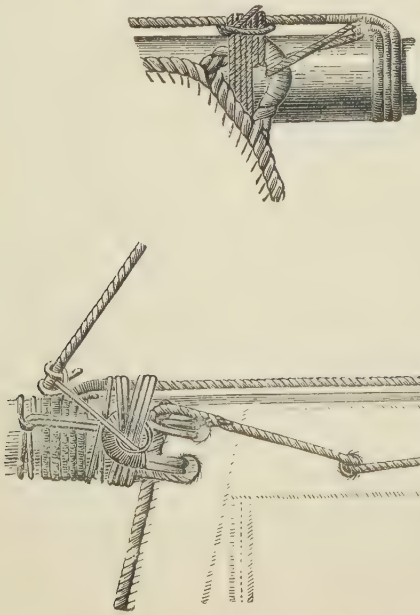
299. Lee Boom-sheet.—By hauling it taut, you would endanger the boom.

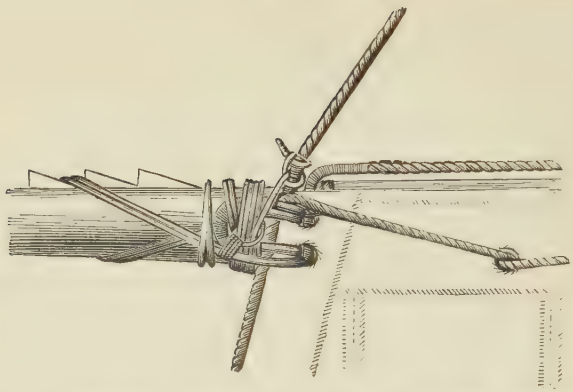
300. Lift and Brace off.—Lower the sail, get hold of the leech, cant the yard, and rig it from the topsail yard.

301. Breeze Freshening.—1st. In royals and flying jib. 2nd. In first reef of topsails. 3rd. In second reefs, and mizen top-gallant sail. 4th. In fore and main top-gallant sails, jib and spanker.—Set fore topmast-staysail and mizen. 5th. In third reefs and reef of courses. 6th. Close reef the topsails, down fore topmast-staysail and set fore staysail. 7th. In mizen topsail. 8th. In fore topsail, courses and mizen.—Set main staysail, and mizen trysail. 9th. In main topsail—if you think it advisable. Yards and masts sent down, and other precautions are of course supposed to be taken.

302. Reefing Topsails.—"Clear lower deck," "reef topsail," "two reefs;" "weather topsail braces," "hands by the topsail halyards," "away aloft;" "let go the top-bowlines, round in;" "lower the topsails," then haul out the reef tackles, turn the yards to the wind, and haul taut the braces, steady taut the top-gallant clewlines to keep the sheets clear of the men reefing; "trice up, lay out;" the sail is then lighted out to windward, the weather earing hauled out, then to leeward; pass the beckets through the reef-line and toggle them; "lay in down from aloft," let go the reef tackles, attend the braces." "Hoist the topsail."

303. Reef-tackle carried away.—Clew the sail up, pass the leech along and reeve the reef-tackle afresh; haul out, take the reef in, and sheet home.





304. Passing earings. *A Head Earing.*—Is spliced into the head cringle of the sail with a long eye. A turn is taken down through the head earing strop, and up through the head earing cringle in the sail. . The sail is middled and hauled taut out and well on top of the yard, one turn is then passed round the jackstay and up through the cringle, then three or four turns round the yard and up through the cringle, the end being hitched round all parts under the jackstay.

First and Second Reef Earings.—Are each rove with a long running eye round the yard-arm, passed from aft forward through the reef cringles and the sail hauled well up on top of the yard, then three turns round the yard up through the cringle, and the end hitched to the lift. If the first inner turn is taken round the yard without being passed through the cringle, the sail will keep up better and the earing is passed quicker.

Third and Fourth Earings.—Are spliced into the lowest eyelet-hole of the reef cringle with long eyes. A turn is taken round the yard-arm, outside the lift, over the

cleats, and through the reef cringle from aft forward. The sail is hauled well up on top of the yard, then three or four turns passed round the yard and up through the cringle. The end after taking a turn round the yard-arm is hitched to the lift. If the first inner turn is passed round the yard-arm only, it will keep up better.

NOTE.—For smartness First and Second reef earings are sometimes passed on the bight as follows:—Haul the reef close out by the outer turn, passed down abaft, through the cringle up before the yard, over the cleat, down abaft, and the bight passed through the cringle, leaving the end abaft the sail. Pass the bight up before and over the yard, rousing the reef well up, then haul back on the end till the bight lies close down on the yard; pass the end through the bight from abaft haul well back and hitch it. For a third or fourth reef, as many inner turns are passed as the cringle will admit of and are passed on the end—not on the bight.

305. FITMENTS OF EARINGS, *The head earing* is spliced into the head cringle of the sail with a long eye.

The first and second reef earings—are rove with a long running eye round the yard-arm.

The third and fourth reef earings—are spliced into the lower reef cringle eyelet-hole, and the end of each is made fast to the cringle above it with a bowline knot.

NOTE. The first reef earing is sometimes formed of two pieces of small rope; the longest spliced into its own part, forming an eye two-thirds the length of the earing; the other spliced into each part of this eye, at equal distances apart,

the bight of the two parts lying square with each other. This tapers the earing, the end consisting of one part, the third quarter of two, the middle three, and the part which forms the first turn of the earing, of four parts. All are marled together; and a seizing is put round the bights; making an eye to go over the yard-arm.

306. After taking in a third Reef.—Get the preventer braces and preventer parrals on.

307. Taking in a Close Reef.—Man the weather brace, rolling-tackle, and clewline, round in, lower the topsail and clew down; check the lower braces if on a wind, haul the reef-tackles close out, easing the sheets, and hauling up on the clewlines at the same time; haul taut both buntlines, secure the yard (not forgetting to haul taut the halyards, as it is hanging by the lifts), trice up and lay out.

A close reef earing is usually passed abaft all, as there is such a mass of sail and leech rope on the fore part, but it is nevertheless doubtful whether the usual plan is not the best for all reefs.

308.—Reefing Courses.—Haul the clew-garnets two-thirds up, and haul up the reef-tackles and buntlines. If on a wind, round in the weather-brace, to clear the sail of the stays; haul taut both lifts, and rolling tackle if on, and truss to; lay out and light over.

309.—Taking in a Course.—Man the weather clew-garnet and leechlines, and both buntlines; ease off a fathom of the main sheet, before starting the tack, lest you spring the yard by suddenly relieving it of so great a strain; then ease away the main tack and bowline, and haul up the

weather clew, take in the lee clew, haul the gear close up, round in the weather brace, and secure the yard for furling (which may be done over all, without tricing the booms up). When furled, place a mat, or old hammock, over the sail in the wake of the stays, previous to bracing up.

310. Setting a Storm Staysail.—Haul the sheet aft before hoisting, having seen the hook moused ; ease away as you hoist, and haul aft again.

311. Sending Top-gallant Masts down at Sea.—Get burtons on the backstays, to ease away as you sway to unfid, and to steady taut as you lower. Send the mast down through lubber's hole with a heel rope rove through a block on deck abreast of the mast, well manned, and kept taut as the mast comes down.

312. Set the Fore Staysail.—*Then* shorten sail in the usual manner.

313. Taking in a Jib in a Breeze.—Keep the ship away, and make use of the gab rope, ease the sheet as the sail is hauled down, aud when the downhaul is secured belay the sheet again.

314. Weather Main-topsail Brace goes.—On a wind, put the helm down, let go the lee main brace, square the main-yard and bring her to the wind with the topsail aback, lash the yard to the topmast rigging, lay out, and put on the preventer brace.

315. With the Wind on the Quarter.—Watch trim sails ; keep her away, let go the halyards, bring the wind on the other quarter, get a preventer brace on, trim and make sail.

316. Preventer Braces.—Yard-tackles for the lower yards, and the long $3\frac{1}{2}$ inch top whips for the topsail yards.

317. Weather Main-topsail Sheet and Clewline gone.—Haul up the buntlines, reef-tackles, and lee clewline; hand the leech in, pass a gasket round the sail to steady it, and reeve the clewline afresh. If, however, you cannot get hold of the leech, unreeve the main topbowline from the fore top, send a hauling-line down for the end, reeve it through the quarter block, haul it up, and so confine the sail till you have passed a gasket, when reeve the bowline again, and the new clewline and sheet.

318. Parral of Main-topsail Yard gone; before the Wind.—Haul taut both clewlines and topsail lifts to steady the yard, and see that the braces bear an equal strain; but do not clew up, as the great object is to keep the yard as steady as possible. Without delay, hang the top-gallant mast rope at the cross-trees, unreeve it altogether, dip it under the rigging, and make a running bowline with it round the mast and topsail tyes; open it well out, send a hand down with it, and slip it over the tye-blocks. In the mean time hands are employed reeving the hauling part through a leading block abaft; clap the watch on, and truss the yard to; get up the spare parral, and set the sail again. If the yard complains, ease off the topsail-sheets, hauling taut the clewlines.

As before remarked, we are not bound to assume that from want of proper care these accidents occur. Therefore if such a case were put as the carrying away of a parral *in a gale of wind*, we should merely suggest that a new one be fitted and got up, and another preventer passed in the mean-

time; for the sound preventer parral, that under the circumstances would be on, would relieve us of all apprehension.

319.—PARRAL GONE, ON A WIND.—Heave the sail aback and clew the yard down, hook a couple of jiggers from the cap for rolling-tackles, clew up if necessary, and get the preventer parral on.

320. TOPMAST-STAY CARRIED AWAY.—Keep the ship away, shorten sail, get up and haul taut the sail-tackle; and replace the stay with a hawser, bowline-knotted round the mast-head.

321. A BOBSTAY GONE.—Take in the top-gallant sails, head sails, and spanker, haul up the mainsail, lower the fore topsail, and keep away if necessary, Send a hand down to knot both parts of the bobstay together—forming a strop: hook the double blocks of two luffs to it, and the single blocks to a strop through the heart in the bobstay collar; reeve the falls through blocks on the bowsprit, set them up and make sail, keeping away and getting a pull of them occasionally.*

If the shroud be gone close to the cutwater, it must be cut away with an axe, and a strop rove through the hole, if it can be got at. But, if in such weather that you cannot send a hand down, you must send the fore top-gallant mast on deck, get the jib-boom in—if it is safe to start it, and the runners and tackles up to relieve the stays, and ease the sail

* NOTE.—This is the correct answer without doubt, but the reviser has seen two bobstay collars out of three, gone in a heavy gale of wind, and nothing the worse, though they could not be replaced until the weather moderated.

carried, until the weather is fine enough to secure the bowsprit effectually. I cannot see that a hawser, taken round the bowsprit and led in through the hawse-holes, would be of any utility, from the small angle it forms with the bowsprit; and in bad weather you would not be able to keep the hawse plugs out.

322. JIB-BOOM CARRIED AWAY.—So much depends upon ever-varying circumstances, that what is recommended in this and similar cases, must only be considered as generally applicable, and not suitable or necessary on all occasions. As a general rule, therefore heave to and get the wreck in, taking in the top-gallant sails, and housing the fore top-gallant mast. If you bear up, or stand on, you will knock the bows about with the broken spars, and find great difficulty in getting hold of them.

323. JIB-SHEET CARRIED AWAY.—*Mind your weather-helm*, haul down the jib, trice the tack of the spanker up, and clear away the fore topmast staysail.

324. MAIN TACK AND CLEW-GARNET GONE.—Bear up or wear, and haul the sheet aft.

325. TILLER-ROPE CARRIED AWAY.—When this occurs, it may be assumed to be blowing fresh. The first thing to be done, therefore, is to steady the rudder, which, in a sea-way would fly from side to side with great violence. The quickest way of doing so will be by means of the remaining rope; and, as the chances are that the weather wheel rope will be the one to go, jamb the helm down, shorten sail, and heave to with the head yards a-box, if you do not want to come round. Otherwise, if there is a ship close astern of you, for instance, haul the mainsail up, and square the main yard in

stays. Should the lee rope go, put the helm up, heave to on the other tack, and shorten sail as soon as possible. If unsafe, from the position of the ship, to do either, chock the rudder up (which, by the way, is not done in a moment when the tiller has taken charge); man the head sheets and cross-jack braces, and steer the ship by the sails. In moderate weather, the relieving tackles will probably be hooked before it will be necessary to touch anything. In all cases send hands down to hook, and work them, and reeve new wheel-ropes.

326. Lower Shroud carried away, and not long enough for turning in afresh.—Turn the dead-eye out, strop it with rope of equivalent dimensions, and seize a large thimble in; knot the shroud, reeve it through the thimble, and seize the end up: reeve the lanyard again, and set the shroud up.

327. Jib Downhaul carried away.—Unbend the lee top-gallant bowline, make a bowline round the stay, and haul down. Should it carry away, send the downhaul up by the weather bowline used as a hauling line, bend it round the stay, and assist it, if the lacing jambs, by hauling down six feet at a time with a rope's-end rove through the lee bowline block at the boom-end.

328. Main Yard sprung on the Weather Quarter; Ship rolling heavily.—Unbend the sail, clew up the top-sail, reeve the jeers and take them to the capstan. Send the studding-sail booms down to lighten the yard, and to get them out of the way. Send an up-and-down on each side through lubber's-hole, lash them to bolts in the cap, and hook them to butt slings round the quarters of the yard. A little further out on each quarter, hook the top burtons to strops on

the yard, and on deck to bolts in the fore part of each gangway. Lower the yard-tackles down, cross them and hook in to the ship's side abreast of the mast. Unshackle one truss, and reeve a stout piece of rope down through one thimble, abaft the mast, under the necklace, and up through the other thimble of the truss stop; to each end hook a burton from the cap, haul taut, and unreeve the other truss. Heave round the jeers, swaying on the quarter tackles at the same time, knock the slip off, and walk back, attending the lifts, yard tackles, preventer truss, and braces, and steadying the yard forward by the burtons. Land it across the netting and lash it there. Strip it of everything in the slings, and knock off the battens and casing to have a good overhaul. If found sprung where it was supposed, place a topmast studding sail boom on the top of the yard, and another on the fore side—supposing the fracture to have occurred there; fill the space up above and below the spring with capstan bars, and handspikes, &c. Get up 230 or 240 fathoms of 3-inch and $3\frac{1}{2}$-inch rounding, or unrove rigging, if you have it; divide it into six lashings, three on each quarter, outside the clothing. Pass the lashings on both ends, each turn bowsed well taut with a jigger, rack each turn as it is bowsed taut by driving nails through it into the yard, and, when finished tautened up with wedges. Then put on the slings, which will require lengthening; lash the clothing on, having tailed the lashings; and sway the yard up, in the same manner in which it is lowered down.

For a slight spring, an iron fish will probably be sufficient to prevent it opening out and spreading further.

329. Fore Yard carried away in the Weather Quarter.—Clew the topsail up, confine and steady the

weather yard-arm by slip-ropes, and unbend the sail the best way you can; hook an up-and-down from the cap to the weather quarter, bend the fore bowline round it, and land it on the forecastle. Reeve four parts of the jeers, and send the lee yard-arm down. Land a spar on the knight-heads, and lash it to the foremast on the lee side, level with the nettings, and across it lay the lee portion of the yard. On another spar from the knight-heads, on the weather side, suspended by a luff from the rigging, and steadied by guys, place the weather yard arm. Bring the broken parts together by luffs and burtons, crossed from opposite sides of the deck, and fish the yard with studding-sail booms. Place one on the after side, above the batten, another on top of the yard, and a third on the fore side; fill up with capstan bars, woold the whole together, and wedge it up taut. While this is being done, the fore tacks and sheets may be singled and shackled to the clews of the fore topsail, and the sail set flying. When finished, sway the fore yard up, bend, and set the sails.

330. SWIFTING IN.—Reeve a rope through a block on each shroud, and bowse on it till the rigging is taut.

331. MAINMAST GOES OVER THE SIDE IN A STORM.—Wear, if possible, and bring the wreck to windward; cut away, and get clear of it as soon as you can.

332. BOWSPRIT BADLY SPRUNG.—Shorten all necessary sail, according to the breeze; send fore top-gallant mast down, secure foremast with runners and tackles, and top-mast with sail tackle, and slacken up the stays, if circumstances require it. Get head sails and flying boom in; and, if the bowsprit is so badly sprung as to lead you to think

that it would be unsafe, when fished, to carry the jib with the boom rigged out the full extent, rig it in for a fish until the heel butts the stem. Place the flying boom on one side, and a topmast studding-sail boom on the other and woold all to gether, wedging and chocking up between. Out of the head-ports on the forecastle, rig, on one side, the spare jib-boom, and, on the other, a hand-mast, or spare mizen-topmast; secure the heels inboard, and lash the heads securely to the head of the bowsprit on either side. Round the centre of one of the shores, secure the standing part of a lashing; reeve it down through the gammoning hole in the cutwater up and over the opposite shore, down through the cutwater again, over the first shore, and so on until sufficient turns are passed, finishing off with a few frapping turns round the lashing and over the bowsprit. The jib may still be set outside the bowsprit cap.

If you intend to get the jib-boom out again, fish the bowsprit with one or two spare anchor stocks hollowed out, assisted with the shores as before.

333. Brought by the Lee.—Put the helm down, and brace round directly, unless in the mean time she answers the helm, and brings the wind on the weather quarter again; though the probability is that you will either lose the masts or be thrown on your beam-ends.

334. Laying a Ship to.—Haul the foresail up; and, if you find that you can run her with safety, for a short time under the topsail and staysail, furl the foresail before bringing her to the wind. If, however, there is such a sea running that you cannot keep before it after shortening sail, look out

for a smooth, down with the helm, and round short to, to avoid exposing her broadside to the sea a moment longer than is absolutely necessary.

335. Broaching to—Is synonymous with coming up into the wind; but is exclusively applied to a ship in bad weather, when it becomes a situation of great danger to the ship and spars. When running free, with the sea on the quarter, want of attention at the helm is the common cause of such a mishap. Put the helm up, lower the topsails if they are standing; and if she does not pay off, box off or brace up, as the occasion demands. Should, however the ship be going over, let fly everything, of course, instantly.

336. Preparations for a Hurricane.—Have plenty of steam up; get the jib-boom whiskers and dolphin striker in; send upper yards, masts and rigging on deck, studding-sails out of the rigging, and booms off the yards. Rolling tackles, preventer braces, and parrals on. Storm staysails bent and ready for setting. Sails close reefed, yards well secured, and rigging mats properly placed to prevent chafe. Gratings, tarpaulins and battens ready for the hatchways. Life-lines along the decks; guns, shot, bucklers, and hawse plugs, boats, booms and anchors well lashed and secured. Ports examined and well barred in. Relieving tackles, spare wheel and binnacles ready. Try the pumps to ensure their being clear and ready for working.

Cook two or three days provisions in advance. Set the storm sails, and take in the topsails in time; see them well furled with sea gaskets. Register the barometer every half hour; make yourself all clear "on the law of storms;" and place your ship on the right tack.

337. THROWN ON YOUR BEAM-ENDS.—Let fly everything —when, if she does not right, or continues to go over, there is no resource left but to cut the lanyards of the weather rigging, if you have time, and let the masts go over the side; at the same time cutting the lashings of the booms, and clearing away the boats. If in soundings, letting go an anchor will bring her head to wind and probably right her.

338. DANGER OF FOUNDERING.—Rig a sea anchor, with three spars in the shape of a triangle, and lash a sail across it; at one corner sling a weight proportionate to the size of the spars, launch it overboard, and ride by it until jury mast can be rigged. If unable to do this, letting go an anchor, and veering a long scope will in some measure steady the ship by bringing her head towards the sea.

339. WATER GAINING ON THE PUMPS.—Heave what guns you can overboard, and otherwise lighten the ship as circumstances will admit.

340. THE LAWS OF STORMS.—The culpable disaster detailed in the question resulted from disregard, or ignorance of these well-known laws, which, had they been attended to, would not only have enabled your friend to avoid all danger from the approaching storm, but would have taught him how to profit by it, and unhesitatingly to turn it to his own advantage. I have space here only to touch on the first principles of this very attractive science; and, for its interesting particulars, must refer the reader to the standard work of Piddington and Reid.*

* Other works that may with advantage be consulted on Revolving storms are :—

Ocean Meteorology by Findlay and Martin, 1887 and,

A considerable time has elapsed since Mr. Redfield, of New York, first drew public attention to the rotatory and progressive notions of storms, which resulted in the discovery of the following laws :—

1. That in the northern hemisphere, their axial rotation is in a direction contrary to that of the hands of a watch, or W. E. ; and that, in the southern hemisphere, they rotate with the hands of a watch, or W. E.

2. That, through some cyclones are almost stationary storms, the majority move onward on a curved track, at a rate varying from one to ten miles an hour in the Southern Ocean, and from ten to forty in the West Indies ; that near the equator, their course is nearly west, diverging to the north in north latitudes, and to the south in south latitudes until they cross the tropics, when the curve becomes more rapid, and they finally re-curve to the eastward. Their dimensions vary from 200 to 600 miles in diameter in the South Indian Ocean, and from 100 to 1,000 miles in the Atlantic. The usual typhoons of the China Sea are from 60 to 300 miles in diameter.

Remarks on Revolving Storms, Admiralty, 1883.
Rotatory Theory of Storms by F.P.B. Martin, 1852.
Meteorology by Loomis, 1884.
Elementary Meteorology by R. H. Scott, 1883.
The Law of Storms by Rosser, 1876.
Handbook of Law of Storms by W. R. Birt, 1878.

3. That there is generally a calm space in the centre where sudden and terrific gusts break the unnatural repose, with a confused and dangerous sea running.*

4. That in the northern hemisphere, the centre bears eight points to the left of the wind, your back being to it; and, in the Southern hemisphere, eight points to the right of the wind.

5. That cyclones are almost always preceded by a falling barometer.†

6. That, to avoid them, you should, when to the right of the cyclone's track, or in the right-hand semicircle, lie to on the starboard tack; and, in the left-hand semicircle, or to the left of it, on the port tack, in both hemispheres. But this, as will subsequently be seen, only holds good when you are far enough from its path to be out of harm's reach, for it then insures you against closing within dangerous limits, and from being taken aback from the shifts of wind, which, if this rule is attended to, will always be aft. When before, or near its track, it is necessary to increase your distance by

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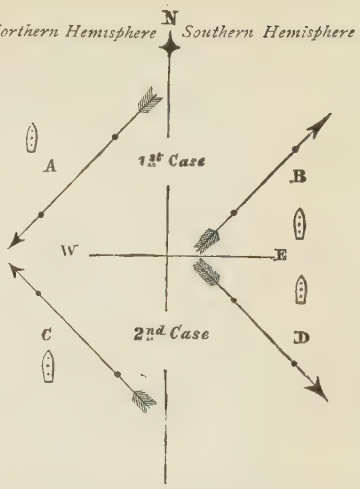
* In the hurricane that passed over Martinique, October 11, 1831, 9,000 people perished; and St. Pierre the sea rose to a height of 25 feet, and 150 houses along the beach disappeared in a moment.

† In the hurricane at Havannah, on October, 12, 1846, the fall of the barometer was so sudden, in a vortex, that the windows of the houses were forced *outwards*.



bearing up or standing off, as the case may be, until the cyclone has passed, when you may resume your course with caution.*

By projecting the track of a storm by the bearing of the centre, it will be seen,—firstly, that when the shifts of wind in either hemisphere occur in the direction N. E.S.W. you are in the right-hand semicircle ; and, secondly, when the wind veers in the contrary direction N.W.S.E., you are in the left-hand semicircle. Consequently, in the first case (see diagram), in north latitudes, the cyclone is travelling from eastward to westward, and in south latitudes from westward to eastward.

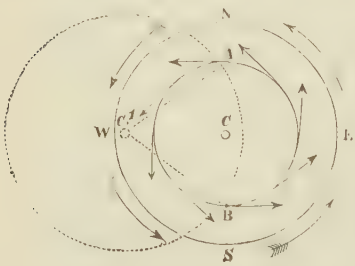
In the second case (see diagram), in north latitudes, its course is from eastward to westward, and in south latitudes, from westward to eastward.

In Diagram A, the ship	at first has wind North, when Centre would be	
	East afterwards.....	East..... South
In Diagram B,	at first...	North..... ..... West
	afterwards.....	East... .. .. North
In Diagram C,	at first.....	North..... .. ...East
	afterwards.....	West ..... North
In Diagram D,	at first.....	North..... ..... West
	afterwards.....	West..... ....South

* In the memorable gale after Rodney's action of the 1st April, 1782, upwards of 3,000 seamen alone are computed to have perished in the fleet and convoy. *They were hove to on the wrong tack...Reid.*

It will be observed that the wind is here spoken of as changing in a direction contrary to that of the storms themselves, which in north latitudes has been stated to be W. E., and in south latitudes W. E. ; for, in the first case given above, shifts of wind are assumed to occur in the direction W E, ; and in the second case, in the direction W. E. In the first case this is contrary to the rotary motion northerly storms, and in the second case contrary to that of southerly storms.

The reason of this will be seen if we draw a circle, N.W. S.E., to represent the body of a storm ; with a ship anywhere within its influence, as at A. Assuming the ship to be in north latitnde, the cyclone will be revolving in the direction shown by the curved arrows, and the wind in each quarter of the storm circle will blow in the direction shown by the straight arrows ; for, though it sweeps *round* by storm's axis, it may, from the small segment occupied by a ship, be represented, as far as she is concerned, as a tangent to the circle.



At A, therefore, she will have the wind from the eastward, and the centre of the storm will be eight points to the left, or south of her. If it is travelling from east to west, the first shift of wind she will expe-

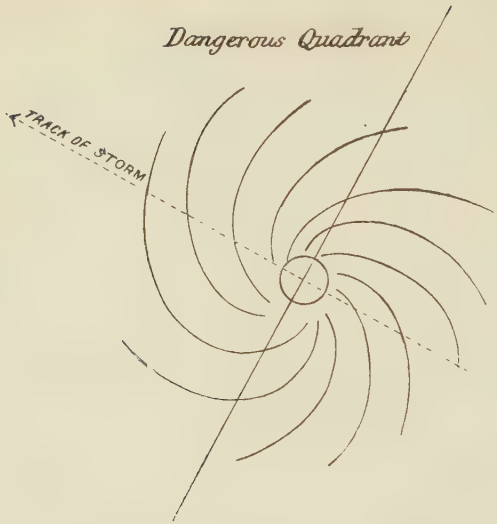
rience will be from S.E. ; for while moving on its course in the direction, C,C′, it will be changing the bearing of its centre from the ship, which, when at C′, will be S.W. of her, with the wind from the S.E. So that, though the storm is revolving in the direction W. E., the wind is shifting in the direction W. E. But if the ship, on the contrary, be in the other semicircle, say at B, she would have the wind at west, when the centre reached C′, at S.W. ; consequently the change being from west to S.W., would *coincide* with the rotatory motion of the storm.

The figure will also show why, if induced to cross the path of a hurricane with a fair wind, you will be deceived by finding it coming round against you as you enter the other semicircle.

At the present time opinions are divided as to whether the winds of a cyclone are revolving round the progressive centre or whether they blow in spirals round that centre. "The practical result at which most modern writers on the subject arrive is that it is not advisable to attempt any great precision in giving rules for the handling of ships in these storms. All that can be done is to give the captain rough and general rules for his guidance. It is certainly incorrect to assert that the centre of a cyclone storm lies exactly at right angles to the direction of the wind." *

The annexed diagram gives a general idea of the way in which the winds are by some authors supposed to blow in spirals round the centre.

* Birt.



According to recent authorities the diameter of revolving storms varies from 50 to 1000 miles, and their approximate rate of travelling as follows :—West Indies 200 miles per day, Indian Ocean 50 to 200 miles per day, Bay of Bengal and China 200 miles per day.

Now referring to the case in point, it will be seen that at 8 P.M., 16th, the prize got the first hurricane-wind, the true nature of which might have been conjectured from the atmospheric appearances—the fall of the barometer, the easterly swell (cyclones in these latitudes usually travelling from the E.N.E.), and from the time of the year (the month of February being that in which the greatest number of hurricanes occur in those latitudes). However, at this early stage to have failed in interpreting the signs is very pardonable ; and

the reason that nothing further occurred during the night was owing to her steering a course in advance of that of the storm. At 6 A.M., 17th, however, it was gaining on the ship, which brings the wind further forward; and, on tacking, and finding the wind increasing and veering in the order to be expected, they should have been on the alert, have carefully watched the barometer, registering it every half-hour and been prepared to escape from the anticipated danger, which would soon unmistakably have declared itself. At 7 or 8 P.M. at the very latest, they should have bore up north and afterwards N.N.E., or thereabouts, as the wind drew forward, and ran until told by a rising barometer, a moderating gale, and the wind's direction that the storm had passed. By noon, 18th, they would probably have run far enough, the wind being W.N.W., and it would have been safe to have hauled gradually round again, keeping away S. E. till the wind was N.W., which they would have got—say about 7 P.M., taking care not to draw too close upon the storm again, nor yet to get beyond its influence. They might then have braced forward on the starboard tack and resumed the voyage, parallel, but in the rear of the storm, with a fine fresh breeze. Its track would probably have soon curved away rapidly to the southward, and carried them five or six hundred miles upon their course; and when their road and the storm's no longer agreed, they might have parted company at their own discretion.

In connection with this subject, the following remarks, taken from the "Meteorological Papers" published by the Board of Trade, will be found of great value.

WIND AND WEATHER.

"Some persons attribute influence to the moon in respect of weather, and say a change may be expected within a few days of the moon's phases. But the interval between one and another phase of the moon is but seven days, and "a few of these days *must* be a time near one phase or another. Accidental coincidences are generally allowed to influence the mind, because, when they occur, they mark any event more particularly. Similar to these are the prejudices against sailing on a Friday, which used to be so general.

"Continued comparisons of changes of weather or wind during many consecutive years, in various parts of the world, have proved decidedly that there is no regular correspondence between the lunar phases and atmospherical changes.

"The following are a few of the more marked signs of weather :—

"Whether clear or cloudy, a rosy sky at sunset presages fine weather; a red sky in the morning, bad weather, or much wind (if not rain); a grey sky in the morning, fine weather: a high dawn, wind; a low dawn, fair weather.*

"Soft looking, or delicate clouds, foretell fine weather, with moderate or light breezes; hard-edged, oily-looking clouds, wind. A dark, gloomy blue sky is windy; but a light, bright blue sky indicates fine weather. Generally, the *softer* clouds look, the less wind (but perhaps more rain) may be expected; and the harder, more 'greasy,' rolled, tufted, or ragged the

* A high dawn is when the first streaks of morning light appear over a bank of cloud, instead of near the horizon, as is usual when there are no heavy clouds.

stronger the coming wind will prove. Also a bright yellow sky at sunset presages wind; a pale yellow, wet; and thus, by the prevalence of red, yellow, or grey tints, the coming weather may be fore-told very nearly; indeed, if aided by instruments, almost exactly.

"Small inky-looking clouds foretell rain; a light scud, driving across heavy clouds, wind and rain; but if alone, wind only.

"High upper clouds crossing the sun, moon, or stars, in a direction different from that of the lower clouds or wind then blowing, foretell a change of wind (beyond tropical latitudes).

"After fine clear weather, the first signs (in the sky) of change, are usually small, curly, streaked, or spotty clouds, followed by an evercasting of vapour that grows into cloudiness. This murky appearance, more or less oily or watery, as wind or rain will prevail, is a sure sign. The higher and more distant the clouds seem to be, the more gradual, but extensive, the coming change of weather will prove.

"Generally speaking, natural, quiet, delicate tints or colours, with soft, undefined forms of clouds, foretell fine weather; but gaudy, or unusual hues, with hard, definite outlines, presage rain and wind."

THE BEAUFORT NOTATION

0—Denotes calm

1—Light air: just sufficient to give steerage way.

2—Light breeze.	With which a well-conditioned Man-of-war under all sail and clean full, would go in smooth water.	1 to 2 knots.
3—Gentle breeze.		3 to 4 knots.
4—Moderate breeze		4 to 5 knots.

5—Fresh breeze. 6—Strong breeze. 7—Moderate gale. 8—Fresh gale. 9—Strong gale.	In which the same ship could just carry close-hauled.	Royals, &c. Single reefs and top-gallant sails. Double reefs, jib, &c. Triple reefs, courses, &c. close reefs and courses.
10—Whole gale.	With which she could only bear.	Close reefed main topsail, and reefed foresail.
11—Storm.	With which she would be reduced to	Storm staysails.
12—Hurricane.	To which she could show	No canvas

THE USE OF THE BAROMETER.

"By attention to the following observations (the result of many years' practice, and many persons' experience), any one not accustomed to use a barometer, may do so without hesitation or real difficulty.

"In all parts of the world, towards the higher latitudes, the quicksilver ranges, or rises and falls nearly three inches, namely, between about thirty inches and eight-tenths (30·8), and less than twenty eight inches (28·0) on extraordinary occasions; but the usual range is from about 30·5 inches, to about 29 inches. Near the line, or in equatorial places, the range is but a few tenths, except in storms, when it sometimes falls to 27 inches.

"If the barometer has been about its ordinary height, say near thirty inches, at the sea level,* and is steady, or

* In different latitudes the ordinary, mean, or normal height may be less, or even more than 30 inches, though *seldom* the latter, except from the tropics to about the thirty-fifth parallel. It stands lower, about a tenth of an inch for each hundred feet of height directly upwards, or vertically, above the sea; when its average height, on the Thames, in England, is 29·94 inches (at 32°).

rising while the thermometer falls, and dampness becomes* less, north-westerly, northerly, or north-easterly wind, or less wind may be expected.†

"On the contrary, if a fall takes place, with a rising thermometer and increased dampness, wind and rain, (or snow) may be expected from the south-eastward, south-ward, or south-westward.

"Exceptions to these rules occur when a north-easterly wind, with wet (rain or snow), is impending, before which the barometer often rises (on account of the *direction* of the

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* If a thermometer has a piece of linen tied round the bulb, wetted enough to keep it damp by a thread or wick dipping into a cup of water, it will show less heat than a dry one, in proportion to the dryness of the air and quickness of drying. In very damp weather, with or *before* rain, fog, or dew, two such thermometers will be nearly alike.

Hence, for ascertaining the dryness or moisture of air, a ready and sure method is the comparison of two thermometers, one dry, the other *just* moistened and *kept so*. Cooled by evaporation, as much as the state of the air admits, the moist (or wet) bulb thermometer shows a temperature nearly equal to that of the other one, when the atmosphere is extremely damp or moist ; but lower at other times in proportion to the dryness of air, and consequent evaporation, as far as twelve or fifteen degrees in England, twenty, or even more, elsewhere. About six degrees of difference is considered healthy in a temperate climate.

Pouring water over the bulb, instead of merely moistening it, imparts to the mercury the temperature of the water, which *may* be higher than that of the air.

† In the southern hemisphere, for North read South, and for South put North, in these pages.

coming wind alone), and deceives persons who, from that sign only (its rising), expect fair weather.

"When the barometer is rather below its ordinary height say near twenty-nine inches and a half (at the sea level *only*), a rise foretells less wind, or a change in its direction towards the northward, or less wet; but when the mercury has been low, say near twenty-nine inches, the first rising usually precedes, and foretells strong wind (at times heavy squalls) from the north-westward, northward, or north-eastward, *after* which violence a rising glass foretells improving weather, if the thermometer falls. But if the warmth continue, probably the wind will back (shift against the sun's course), and more southerly, or south-westerly wind will follow.

"The most dangerous shifts of wind, and the heaviest northerly* gales happen after the mercury first rises from a very low point.

"It may be repeated that indications of approaching changes of weather, and the direction and force of winds, are shown less by the height of mercury in the tube, than by its falling or rising. Also that a height of about thirty inches or upwards at the level of the sea) is indicative of fine weather and moderate winds.

"A rapid rise of the barometer indicates unsettled weather. A slow rise or steadiness, with dryness, shows fair weather.

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* Southerly in south latitude. The movements are the same with east and west winds in both hemispheres; but if there be a rise in an instrument with a north wind in the northern hemisphere, it sinks with a north wind in the southern, and *vice versâ*. The same occurs with south winds.

"A considerable and rapid fall is a sign of stormy weather and rain. Alternate rising and sinking show very unsettled weather.

"The greatest depressions of the barometer are with gales from the S.E., southward, or S.W.; the greatest elevations with winds from the N.W., northward, or N.E.

"Although the barometer generally falls with a southerly and rises with a northerly wind, the contrary *sometimes* occurs; in which cases the southerly wind is dry and the weather fine, or the northerly wind is wet and violent.

"When the barometer sinks considerably, high wind, rain or snow will follow. The wind will be from the northward, if the thermometer is low (for the season) from the southward, if the thermometer is high, for the time of year and the locality.

"Sudden falls of the barometer, with a westerly wind, are sometimes followed by violent storms from N.W., or north.

"If a gale sets in from the eastward or S.E., and the wind veers by the south, the barometer will continue falling until the wind becomes S.W., when a comparative lull may occur; after which the gale will be renewed; and the shifting of the wind towards the N.W., will be indicated by a fall of the thermometer, as well as a rise of the barometer.

"As a general rule, the wind usually veers, shifts, or goes round, *with the sun* (right-handed in northern places, left-handed in the southern parts of the world), and when it does not do so, or backs, more wind or bad weather may be expected, instead of improvement.

"This veering of the winds is a direct consequence of the earth's rotation, and currents of air from the polar regions alternating or contending with others from the equator. The polar currents are cold, dry, and heavy. Those from the equatorial parts of the world are warm, moist, and comparatively light. Their alternate or combined action (*foretold* by the glasses and other signs), solar heat, and electricity, cause all the varieties of weather that we experience.

"In a barometer the mercury begins to rise occasionally before the conclusion of a gale, sometimes even at its commencement, as the equilibrium of the atmosphere begins to be restored. Although the mercury falls lowest before high winds, it frequently sinks considerably before heavy rain. The barometer falls, but *not always*, on the approach of thunder and lightning, or when the atmosphere is highly charged with electricity. Before and during the earlier or middle part of severe and settled weather, the mercury commonly stands high and is stationary.

"Instances of fine weather, with a low glass, occur exceptionally; but they are always preludes to a duration of wind or rain, *if not both.*

"There may be heavy rains or violent winds beyond the horizon and the view of an observer, by which his instruments may be affected considerably, although no particular change of weather occurs in his immediate locality.

"The caution already given should be specially remembered, that the longer a change of wind or weather is foretold by the barometer before it takes place, the longer the pre-

saged weather will last; and conversely, the shorter the warning, the less time, whatever causes the warning, whether wind or a fall of rain or snow, will continue.

"The tides are affected by atmospheric pressure, so much that a rise of one inch in the barometer will have a corresponding fall of the tides of nine to sixteen inches, or say one foot for each inch.

"Vessels sometimes enter docks, or even harbours, where they have scarcely a foot of water more than their draught; and as docking, as well as launching large ships, requires a close calculation of height of water, the state of the barometer becomes of additional importance on such occasions."

The following old sea rhymes are very good, and worthy to be remembered,

When the glass falls low,
Prepare for a blow;
When it rises high,
Let all your kites fly.

First rise, after low,
Indicates a stronger blow.

Long foretold, long last:
Short notice, soon past.

In Squalls:—

When the rain's before the wind,
Halyards, sheets, and braces mind.
When the wind's before the rain,
Then hoist the topsails up again.

TABLE SHOWING THE FORCE AND VELOCITY OF THE WIND,
BY SIR W. SNOW HARRIS.

Pressure in lbs. per Sq. Foot	Velocity in Miles per Hour.	Popular Descriptions.	Pressure in lbs. per Sq. Foot.	Velocity in Miles per Hour.	Popular Descriptions.
0·002	0·68	Gentle airs (unappreciable by gauge)	1·042	15	Fresh breezes, top-gallant sails and royals.
0·004	1		1·170	16	
0·005	1·06		1·250	16·5	
0·019	2	Light airs (just appreciable by gauge) would fill the lightest sail of a yacht.	1·302	17	Fresh winds; reefs.
0·028	2·5		1·430	17·8	
0·032	2·66		1·470	18	
0·043	3		1·563	18·67	Strong winds; treblereefed topsails.
0·052	3·3	Light breezes, such as would fill the lightest sails of a large ship.	1·630	19	
0·065	3·8		1·790	20	
0·071	4		1·820	20·14	Gales; close-reefed topsails and reefed courses.
0·090	4·5		2·084	21·47	
0·100	4·75		2·600	24	
0·112	5		3·126	26·4	
0·130	5·38		3·647	28·52	Strong gales; close-reefed topsails, and stay-sails.
0·136	5·5		4·168	30·56	
0·162	6		4·689	32·34	
0·228	7		5·200	34	
0·260	7·6		7·800	41	
0·291	8	Moderate breezes, in which ships can carry all sail.	10·400	48·2	Heavy gales and storms.
0·364	9		13·000	53·91	
0·390	9·27		15·600	59	
0·452	10		20·800	68·18	Very heavy gales great storms; tempests.
0·521	10·77		26·000	76·18	
0·551	11		31·200	83·6	
0·650	12		36·400	90·12	Tornadoes; cyclones; hurricanes.
0·780	13	Fresh breezes, top-gallant sails and royals.	41·600	90·34	
0·830	13·6		52·000	107·7	
0·884	14		62·400	120	
0·910	14·25				

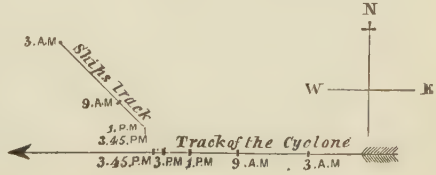
341. THE LAWS OF STORMS (*continued*).—In this case had the subjects of it, as late as 9 A.M., when their apprehensions were first awakened, shortened sail, brought to on the starboard tack, and made the necessary preparations for a heavy gale of wind, which they still would have had. they would have escaped uninjured. The centre of it

would have approached as near to them as it subsequently was about 1 P.M. ; and then, gradually receding, would have allowed them to proceed on their voyage. Instead of which, lured on by the prospect of a good run to the southward, and entertaining the erroneous idea that running before it was the most likely means of running out of it, they hit upon the most direct method for running headlong into it, which they accordingly did, and, as we have seen, narrowly escaped with their dismasted ship.

This being an example of a cyclone in north latitudes ; at 3 A.M., therefore, if the ship was within its influence, the centre must have bore E.S.E., or eight points to the left of the wind ; consequently the course steered, S E., tended to lead her directly for it, if, as was afterwards proved to be the case, the track of the cyclone, in conformity with their usual course in these latitudes, was to the westward ; and the fallacy of running *from it*, as they supposed, is full evident.

There having been little difference between the progressive motion of the storm and the speed of the ship, no considerable alteration in its bearing occurred until 1 P.M., when the wind, having come round to N.E. by N., showed the bearing of its centre to be S.E. by E. As they closed, these changes necessarily occurred more rapidly ; and hence the danger, when on the wrong tack, of being taken aback as they in this instance were.

In the morning, the wind having drawn round to the southward, showed that the storm had



passed away to the westward, and that no further mischief was to be apprehended from this formidable meteor.

342. SHIPS CLOSING IN A CALM.—Send the boats of both ships to the smaller, or to the one whose head is in the best direction.

343. TO ASCERTAIN THE ANGLE OF THE YARDS.—Paste on a looking-glass a paper semicircle with the degrees marked. Draw a fore-and-aft line along the deck; on it place the side of the semicircle, under the yard; and the reflection will indicate the angle.

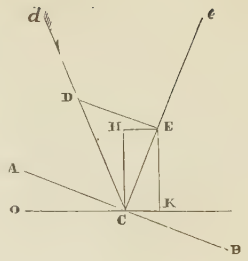
Or, if the ship is upright, you may ascertain it by dropping a plumb-line from two points along the yard, and running a line along the deck between them, which, cutting the fore-and-aft line, will denote the angle by Gunner's quadrant.

344. WHY UPPER YARDS, ON A WIND, BEAR BRACING IN ABAFT THE LOWER YARDS.—The smaller the sail the more taut it can be set, and the less belly is given to it in consequence; therefore the plane of such sail makes a larger angle when the angles of the yards are equal.

345. THE AFTER YARDS BRACE UP SHARPER THAN THE HEAD YARDS.—And they "touch" together, because the eddy wind, out of the sails on the foremast, striking the after sails, renders it necessary that they should be placed sharper up in order to receive the true wind less obliquely.

346. STRAIN ON A WEATHER BRACE.—On first striking the sail, a current of air presses with equal force on all parts of the surface; but the moment it meets with the resistance offered by the sail, it escapes by passing away to leeward; and this stream passing off the weather side of the sail, neutralizes the direct effect of the wind to leeward, and so relieves the lee yard-arm.

347. WHY A SHIP GOES TO WINDWARD.—Let AB represent one of the yards of a ship that is close-hauled. C*d* the direction, and CD the force of the wind ; CE the effected force of the wind upon the sail (= CD × cos. DCE) communicated in the direction C*e* perpendicular to its surface.



Resolve the force CE into its equivalents CK, CH (the one in the directions of the keel, and the other perpendicular to it), and the former will represent the force exerted to drive the ship ahead in the direction CO, and the latter to set her to leeward.

The direct force is equal to the lateral force when the wind will admit of the yard being trimmed at an angle of 45° with the keel : but it will decrease as the yard is braced forward to that point.

The ship is forced ahead—notwithstanding the excess of lateral force, because the resistance offered by the bow is so much less than that presented by the broadside. Evidently therefore (leaving leeway out of consideration), as a ship will sail at a less angle to the wind than eight points, she will, on each tack, go to windward of a line drawn from her position at right angles to the wind, and by thus working, will actually approach the quarter from whence the wind is blowing.

348. FORE CHAINS CARRIED AWAY, AND CHAIN-PLATES DAMAGED.—Set the rigging up with luffs to the bolts in the ship's side placed there for that purpose ; two luffs to a shroud Replace what chain-plates require it with spare ones, and

keep them out in their place with a chock of wood between them and the ship's side ; then set the rigging up properly.

349. Getting Quarter and Stern Boats in-board.—Quarter boat. Wooden davits. Run the sail-tackle up to the main topmast head, abaft the mast, and hook it to the foremast slings ; haul taut, take the weight of the boat, and come up the fall. Hook an up-and-down from the mizen-mast head to the foremost davit, pull up, knock the bolt out, unship the davit, and then fleet the up-and-down to the after slings. Pull up the sail-tackle and get the bows of the boat in, clear of the backstays ; then pull up the up-and-down, overhaul the after fall, unhook it when in board, and transport the boat where you please.

Stern boat. Shift one of the boom topping lifts (which should be fitted to unhook), to the boom end, top it well up, and hook a burton and a jigger to a strop on the end of the boom. Sling the boat a little before the centre, and hook the burton. To the bolt in the stern hook the jigger. Haul both taut and unhook the falls : lower the jigger, cant the stern of the boat out, and the bows in ; then pull up on the burton, haul forward on the painter, and get the bows in on the rail ; pull up on the jigger, light to the burton, and lift her in on the deck.

A cover laced over a boat will prevent her filling, when in danger of being washed away, and you are unable to top her up or get her inboard.

350. Prepare for Action.—Have steam ready for full speed, unbend sails, get top-gallant masts on deck, send down studding-sail booms, top-gallant rigging, and as much running gear as possible ; get the topsail yards and mizen

topmast on deck. House the fore and main topmasts, rack the top tackle pendants and unreeve the falls ; lash the heads and heels of the topmasts to the lower mast, that they may help to support it if wounded ; run in jib-boom and bowsprit if so fitted ; it would also be advisable, I think, if the weather will permit, to clear away some of the lanyards of the lower rigging, and have everything clear for cutting away the lanyards left secured.

Brace the lower yards sharp up, and hang them, also take any other precaution that may suggest itself to you, in order to ensure the masts, if they should unfortunately be shot away, going clear of the ship at once, instead of falling alongside, masking your guns, or worse still fouling the screw the very life of the ship, and without which you must fall an easy victim to the ram or guns of your opponent. If the sails cannot be stowed away below, they should be well wetted, and rolled taut up. Boats' davits should be topped and secured ; spare wheel ropes rove, relieving tackles in readiness, rudder pendants cut adrift, and led in-board ; yards and stays ready for hoisting out boats. Before commencing an action, decks should be wetted and sanded ; bulkheads triced up, tubs of water distributed about the decks, pumps tried, hoses screwed on to the steam main, and every possible preparation made against fire.

The unrove running rigging may be worked into rope mantlets, which, when hung up to the ship's side between the guns, prove a most effective protection from splinters, small fragments of iron, &c.

It is well to remark that on this subject there is another opinion, viz., that in masted ships when preparing for action

the top-gallant masts and studding sail booms only should be sent down from aloft, in other respects the ship should be ready for making sail, it may be urged against this that there is more likelihood of the screw being fouled by falling spars &c., but on the other hand the stowage of the spars and top hamper on deck must of necessity increase the danger of casualties arising from splinters.

351. ENGAGING AN ENEMY.—No positive rule can be laid down, as so much must depend upon circumstances, and the nature of the opposing ships. But this may be said, that the windward position allows better pointing and the smoke clears off instead of blowing into the ports. In iron-clads, especially turret ships, the more oblique angle of side you can expose to the shot of your enemy, while keeping your own guns bearing, the greater will be the defensive power of your plating, and the more favourable position will you be in, should a chance of using the ram occur, while your rudder and screw are safe from injury if you attack in this manner bow on.

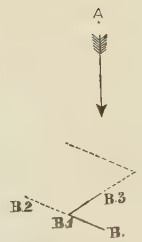
352. CHASING TO WINDWARD.—Work up, as close as possible, in a line dead to leeward of the chase, because, the longer you stand on beyond this, the better you will lie on the other tack (and consequently are doing so much the worse on the present tack). Therefore, tack as frequently as you can on either side of that bearing from the chase which coincides with the direction of the wind.

Let A represent the chase at noon, ten miles dead to windward of the chaser B.

B^1. The position of the chaser, at the rate of four miles an hour, when she tacked at 12.30 P.M.

B^3 Her position at 1 P.M., and

B^2 Her position at the same time, supposing her to have stood on (under a popular notion), until she had brought the chase abeam.



Now, from B^1 the chase bears N. by E. seven points from the course the chaser is lying. The latter consequently tacks, and lies up on a course five points off the chase, which, of course, is better than standing on as she was. Supposing, however, that she ignorantly stands on until she brings the chase abeam B^2, and the chase also tacks, her position then would be a mile further from the chase than if she had tacked earlier, for she would then, as has been shown have been at B^3, steadily following the chase up without giving her a chance of escape.

353. On the Chase tacking when she can fetch the Chase.—Whether the chase should tack, also, depends upon whether the chaser is astern of her, or on the bow; if on the lee bow, the chase should tack also, for, if she stood on, she would close her pursuer until they met, if the chase tacked at a proper time. But, if coming up astern, she should stand on, for, were she to tack, she would near the chaser until she arrived in the wind's eye of her, when any shift of wind whatever would be greatly to her advantage. In either case *the chase should keep on the same tack as the chaser*, who then only by superior sailing will be enabled to close.

354. Chasing to Leeward on a Steamer.—Steer, by a rough guess, the course that you think will enable you to intercept the chase, and take her bearing. If you find that she is heading you, it shows that you have kept away too much, and should haul up a little ; but, if dropping, you may edge away a little more. Consequently *the direct course, for the point at which you would meet, will be that on which her bearing remains the same*, should her course not be altered, or your relative rates of sailing vary. She should be closely watched ; and if she alters her course, you must at once adopt a fresh one.

If the chase sail better than ships in general with the wind abeam, quarterly, aft, or on a wind, as the case may be, she should be ready to take advantage of it, if there is any considerable distance between you; by gradually bringing you on that bearing which will enable her to steer directly from you on that particular point of sailing she has an advantage in. If, however, she has little choice in that respect, she should endeavour to gain ground by watching her pursuer narrowly, and gradually altering her course when she observes that she has hit off the proper bearing,

355. How Grenville fought the Spaniard.—"In August, 1591, Lord Thomas Howard, with six English line-of-battle ships, six victuallers, and two or three pinnaces, were lying at anchor under the islands of Florez. Light in ballast and short of water, with half their men disabled by sickness, they were surrounded by a Spanish fleet of 53 ships. Eleven out of the twelve English ships obeyed the signal of the admiral to cut or weigh their anchors, and escape as they might. The twelfth, the 'Revenge,' commanded by Sir Richard

Grenville, of Bideford, was unable for the moment to follow, of the crew of 190, ninety being sick on shore, and from the position of the ship, there being some delay and difficulty in getting them on board. But Sir Richard was in no haste to fly. He first saw all his sick on board and stowed away on the ballast, and then, with no more than 100 men left him to fight and work the ship, he deliberately weighed, uncertain as it seemed at first, what he intended to do. The Spanish fleet were by this time on his weather bow, and he was persuaded (we here take his cousin Raleigh's beautiful narrative and follow it in his own words), to cut his mainsail and cast about, and trust to the sailing of the ship.

"But Sir Richard utterly refused to turn from the enemy, alleging that he would rather choose to die than to dishonour himself, his country, and her Majesty's ship, persuading his company that he would pass through their two squadrons in despite of them, and enforce those of Seville to give him way; which he performed upon divers of the foremost, who, as the mariners term it, sprang their luff and fell under the lee of the 'Revenge.'

"The wind was light; the 'San Philip,' a 'huge high-carged ship, of 1500 tons came up to windward of him, and taking the wind out of his sails, ran aboard him. The Spanish ships were filled with soldiers, in some 200, besides the mariners; in some 500, in others 800. * * * * After many interchanged volleys of great ordnance and small shot the Spaniards deliberated to enter the 'Revenge,' and made divers attempts hoping to force her by the multitude of armed soldiers and musketeers; but were still repulsed again and again, and at all times beaten back into their own ship or into the sea.

"All that August night the fight continued, the stars rolling over in their sad majesty, but unseen through the sulphur clouds which hung over the scene. Ship after ship of the Spaniards came on upon the 'Revenge,' 'so that never less than two mighty galleons were at her side ; and aboard her. Before morning fifteen several armadoes had assailed her, and all in vain ; some had been sunk at her side and the rest, so ill approving of their entertainment, that at break of day they were far more willing to hearken to a composition, than hastily to make any more assaults or entries."

"All the powder in the 'Revenge,' was now spent, all her pikes were broken, 40 out of her 100 men killed, and a great number of the rest wounded. Sir Richard though badly hurt early in battle, never forsook the deck till an hour before midnight ; and was then shot through the body while his wounds were being dressed, and again in the head, and his surgeon was killed while attending on him, The masts were lying over the side, the rigging cut or broken, the upper works all shot in pieces, and the ship herself, unable to move, was settling slowly in the sea ; the vast fleet of Spaniards lying round her in a ring, like dogs round a dying lion, and wary of approaching him in his last agony. Sir Richard seeing that it was past hope, having fought for fifteen hours, and 'having, by estimation, eight hundred shot of great artillery through him commanded the master-gunner whom he knew to be a most resolute man, to split and sink the ship, that thereby nothing might remain of glory or victory to the Spaniards ; seeing in so many hours they were not able to take her, having had above fifteen hours time, above ten thousand men, and fifty-three men-of-war to perform it withal

and persuaded the company, or as many as he could induce to yield themselves unto God and to the mercy of none else; but as they had, like valiant resolute men, repulsed so many enemies, they should not now shorten the honour of their nation by prolonging their own lives for a few hours or a few days.'

"The gunner and a few others consented. But such δαιμοίνη ἀρετὴ was more than could be expected of ordinary seamen. They had dared do all which did become men, and they were not more than men, at least than men were then. Two Spanish ships had gone down, above fifteen hundred men were killed, and the Spanish admiral could not induce any one of the rest of his fleet to board the 'Revenge' again, 'doubting lest Richard would have blown up himself and them knowing his dangerous disposition'! Sir Richard lying disabled below, the captain, finding the Spaniards as ready to entertain a composition as they could be to offer it, gained over the majority of the surviving crew: and the remainder then drawing back from the master-gunner, they all, without further consulting their dying commander, surrendered on honourable terms; 'the ship being marvellous unsavourie,' Alonzo de Bacon, the Spanish admiral, sent his boat to bring Sir Richard on board his own vessel. Sir Richard whose life was fast ebbing away, replied that 'he might do with his body what he list, for that he esteemed it not;' and as he was carried out of the ship, he swooned, and reviving again, desired the company to pray for him. In a few hours, Sir Richard, finding his end approaching, showed not any sign of faintness, but spoke these words in Spanish, and said, 'Here

die I, Richard Grenville, with a joyful and quiet mind, for that I have ended my life as a true soldier ought to do that hath fought for his country, queen, religion and honour. Whereby my soul most joyfully departeth out of this body, and shall always leave behind it an everlasting fame of a valiant and true soldier, that has done his duty as he was bound to do.' When he had finished these or other such-like words, he gave up the ghost with great and stout courage, and no man could perceive any sign of heaviness in him.

"Such was the fight at Florez, in August of 1591, without its equal in such of the annals of mankind as the thing which we call history has preserved to us. At the time, all England and the world rang with it. It struck a deeper terror, though it was but the action of a single ship, into the hearts of the Spanish people; it dealt a more deadly, blow upon their fame and naval strength than the destruction of the Armada itself; and in the direct results which arose from it, it was scarcely less disastrous to them. Hardly, as it seems to us, if the most glorious actions which are set like jewels in the history of mankind are weighed one against the other in the balance,—hardly will those three hundred Spartans, who, in the summer morning, date 'combing their long hair—for death,' in the passes of Thermopylæ, have earned a more lofty estimate for themselves than this one crew of modern Englishmen

"After the action there ensued 'a tempest so terrible, as was never seen or heard the like before.' A fleet of merchantmen joined the armada immediately after the battle, forming, in all, 140 sail; and of these 140, only 32 ever saw Spanish

harbour. The rest all foundered, or were lost on the Azores. The men-of-war had been so shattered by shot as to be unable to carry sail ; and the ' Revenge ' herself, disdaining to survive her commander, or, as if to complete his own last baffled purpose, like Samson, buried herself and her 200 prize crew under the rocks of St. Michael."*

After reading this each man's feelings will be the best comment ; but, if his patriotism be not stimulated, his motives purified, and his spirit fired by such an example, he is not to be envied ; for it stands alone, even among those marvellous exploits—

"That fill
The spacious times of great Elizabeth
With sounds that echo still."

356. Trial of Sailing.—To ascertain the results, you assume your own ship throughout the trial to be a fixed point and lay off from it, at the commencement and end of the trial, the bearing and distance of the ship or ships with whom you are competing. The bearing is obtained by compass ; and the distance is deduced from the mast-head angle, the height of the mast-head being previously ascertained.

Trials of sailing resolve themselves into two classes—on and off the wind. The test of the former is limited to the direct distance gained in the wind's eye ; while in the latter the whole distance run determines the result.

A single example of each will be sufficient to explain all that need be said upon the subject.

* England's forgotten worthies. —*Westminster Review.*

ON A WIND.

Let it be supposed that at half-past seven, on the morning of October, 3rd, 18—, Her Majesty's ships "Pallas," "Minerva," "Nymphe," "Cleopatra," on signal from the former, made all sail and hauled to the wind preparatory to trying rate of sailing; that at 8 a.m., the signal was made to take bearings and angles, and that the following was the result on board the "Minerva," then, and at the close of the trial 11 a.m., the other ships at the same time making similar observations, and arriving thereby at independent conclusions.

It must be borne in mind that, on every shift of wind, you must take fresh bearings and angles and either commence a new trial or close it.

When many ships are concerned, it is advisable, to avoid confusion, to protract a separate diagram for each position, and not to unite two as has been done above.

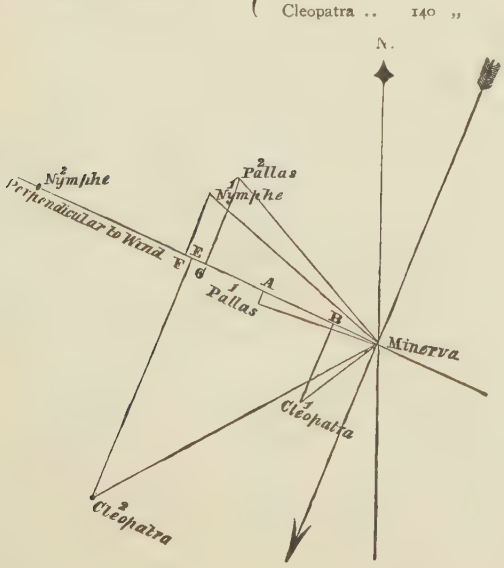
The senior officer should signal to take bearings and angles simultaneously every hour, so that, should any alteration for the better or worse take place in any ship's sailing, the cause may be ascertained from knowing the time when it originated. Also, in the event of any mistake occurring or accident happening to any particular ship, you may, on subsequent consideration, find it judicious to close her part in the trial at one of the intermediate hours, which you have therefore an opportunity of doing.

In taking angles, the mast-head should be brought down to a point level with the observer's eye, otherwise the angle at the base is more, or less, than a right-angle. Consequently the angle subtended by the mast-head and hammock-netting

when the observer is on the deck of his own ship, is more correct than that between the mast-head and water-line. The distance, moreover, between the latter is not a constant number, being affected by the distance the ship is from you.

Time.	Ships.	Bearings.	Angles.	Wind.	Remarks.
8 A.M.	Pallas ..	N. 73° W.	2° 40′	N.N.E.	10h. 15m, Tacked together.
	Nymphe	N. 49 W.	1 10		10h. 20m. Cleopatra unable to carry royals.
	Cleopatra	S. 55 W.			
11 A.M.	Pallas ..	N. 40 W.	1 35	,,	Steady breeze throughout.—Rate of sailing, 5½ to 6 knots.
	Nymphe	N. 67 W.	0 46		
	Cleopatra	S 62 W.	0 52		

Height of mast-heads .. { Pallas .. 167 feet; Nymphe .. 140 ,,; Cleopatra .. 140 ,,



"PALLAS."

Positions at 8 A.M.	Positions at 11 A.M.
167 feet and $\angle$ 2° 40′ gives $MP^1 = 597$ fathoms	167 feet and $\angle$ 1° 35′ gives $MP^2 = 1009$ fathoms
NMA $(90° - 22\frac{1}{2}°) = 67\frac{1}{2}°$ $AP^1 = MP^1 \times \sin. AMP^1$	$NMP^2 = 40°$ ..... $GP^2 = MP^2 \times \sin. GMP^2$
NMP^2 (73° ... .2·775974	GMP^2 $(67\frac{1}{2}° - 40°) = 27\frac{1}{2}°$ ... 9·664406
AMP^1 $(73° - 67\frac{1}{2}) = 5\frac{1}{2}°$.....8·981573	3·003891
57..... ..1·757547	466... . .....2·668297

Commencement of Trial.....57 fathoms to leeward of "Minerva."
End.....466 fathoms to windward.

Gain on "Minerva" in 3 hours..523 fathoms.

"NYMPHE."

$MN^1 = 1046$ fathoms . .....$FN^1 = MN^1 \times \sin. FMN^1$ $MN^2 = 1744$ fms. Deduced from mast-head angle.
$NMN^1 = 49°$..... .... 3·019532
FMN^1 $(67\frac{1}{2}° - 49°) = 18\frac{1}{2}°$.....9·501476

332 ...., ...2·521008

Commencement.....332 fathoms to windward.
End of Trial, equal.
Loss on "Minerva".....332 fathoms

"CLEOPATRA."

$MC^1 = 445$ fathoms.....$BC^1 = MC^1 \times \sin. BMC^1$	$MC^2 = 1542$ fathoms. $EC^2 = MC^2 \times \sin. EMC^2$
2·648360	3·188084
BMC^1 $(180° - \overline{55° + 67\frac{1}{2}°}) = 57\frac{1}{2}°$...9·926029	EMC^2 $(180° - \overline{62° + 67\frac{1}{2}°}) = 50\frac{1}{2}°$...9·887406
375.....2·574389	1190 .... 3·075490

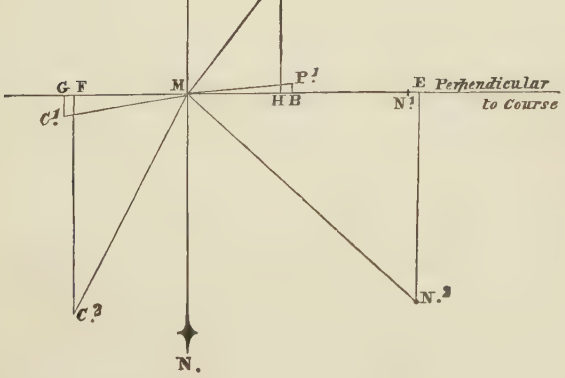
Commencement of Trial.....375 fathoms to leeward of "Minerva."
End..... 1190 "

Loss..... 815 fathoms.

OFF THE WIND.

To illustrate a trial of this description, let it be assumed that in the afternoon the same ships took up position east and west of the "Pallas," and when, at 1.30 P.M., all were fairly started under all sail, that the bearing and angles by signal were taken; were repeated at 2.30, and again

Time.	Ships.	Bearings.	Angles.	Course	Wind.	Remarks.
1.30 P.M.	Pallas....	S. 85°W.	5° 54′	South	North	All ships carried studding sails both sides.
	Nymphe	West	2 20	7·5 knots	6, b. c,	
	Cleopatra	N. 81 E	4 30			
4 P.M.	Pallas....	S. 39 W	4 15			3 P.M. "Cleopatra" carried away port fore topmast studding-sail boom; 3.20 sail set again.
	Nymphe	N. 47 W	1 50			
	Cleopatra	N. 29 E.	2 18			



"PALLAS."

Positions at 1.30 P.M.

$MP^1 = 250$ fms. $BMP^1 = 5°$ $BP^1 = MP^1 \times \sin. BMP^1$

2·397940
8·940296

22 ..... 1·338236

Positions at 4 P.M.

$MP^2 = 366$ fms. $HMP^2 = 51°$ $HP^2 = MP^2 \times \sin. HMP^2$

2·563481
9·890503

284..... 2·453984

Commencement of Trial.....22 fathoms ahead of "Minerva."
End.....284 fathoms " "

Gained on "Minerva".....262 fathoms.

"NYMPHE,"

$MN^2 = 729$ fms. $EMN^2 = 43°$ $EN^2 = MN^2 \times \sin. EMN^2$

2·862727
9·833783

497..... 2·696510

At commencement of Trial..... ....abeam of "Minerva."
At conclusion..... .....497 fathoms astern.
Therefore "Minerva" beat her that distance.

"CLEOPATRA."

$MC^1 = 296$ fms. $GMC^1 = 9°$ $GC^1 = MC^1 \times \sin. GMC^1$

6·471292
9·194322

46..... 1·665624

$MC^2 = 581$ fms. $FMC^2 = 61°$ $FC^2 = MC^2 \times \sin. FMC^2$

2·464176
9·941819

508..... 2·705905

At starting.....46 fathoms astern of "Minerva."
At close.....508 fathoms "

Lost on "Minerva."—.....462 fathoms.

at 4 P.M., when the trial closed; and that the following observations were made by the "Minerva." (The intermediate ones are not noticed).

The "Pallas," therefore, proved herself the best ship on both points of sailing; the "Minerva" second; and, of the other two, the "Nymphe" best on a wind, and "Cleopatra" before it.

357. TOPSAIL-YARD SPRUNG IN A TRIAL.—Fish it temporally with a couple of capstan bars.

358. MAIN TOPSAIL SPLIT ACROSS THE HEAD.—Take a reef in.

359. STOPPERING THE LEECH OF A TOPSAIL.—Settle the halyards, cut a piece of rope long enough to connect the parts of a leech rope, work a knot in each end, send a hand down in a bowline, and pass a seizing round the leech and under each knot.

360. MAINSTAYS CARRIED AWAY.—Bear up, trice up runners and tackles, then haul your wind.

361. RIGGING-STOPPER.—Two pieces of rope, the required length, are middled, the dead-eyes seized in, and the tails coach-whipped. The lanyard is rove, and an eye, spliced in each end, as either end becomes the standing part, according to whichever happens to be put on uppermost. The rigging is brought to by taking a half-hitch with each tail

opposite ways round the shroud, dogging the upper tails upwards, and the lower ones downward along the shroud, above and below the part that is wounded, and securing it with a nettle in each tail. The double block of a stout jigger is then hooked to a selvagee strop round the shroud, above the stopper, and the single block to the eye in the lanyard in the lower dead-eye. The eye in the other end bringing up against the dead-eye acts as a knot; and the shroud is then set up.

362. SPARE COMPASS CARDS.—Should be stowed with the poles of *different names* next to each other.

363. WITHOUT A COMPASS.—A piece of hard iron or steel held in a perpendicular position (or more correctly speaking, in a position in which it points to the magnetic pole), and struck smartly with a hammer, will acquire and *retain* the magnetic property. In the northern hemisphere the north pole will be the end which was lowest, and in the southern hemisphere that which was held uppermost. The sun by day and the stars by night are the only other guides you have.

In Captain Golowin's narrative of his captivity in Japan in 1811—13, he relates how they imparted magnetism to a needle by rubbing it with a stone. "The proverb that necessity is the mother of invention," he observes, "was fully realized; for Mr. Chlebnikoff even managed to make a compass. We requested our attendants to let us have two large needles for mending our clothes, and afterwards pretended

that we had lost them. The Japanese sometimes fasten together the beams of their houses with copper; this had been done in our house, although the copper was very rusty. Mr. Chlebnikoff cleaned a piece of this copper, in the middle of which he bored a hole, so that a needle might be placed upon it. By frequently rubbing this needle on a stone which he selected for the purpose, he succeeded in magnetising it, and finally gave it such a degree of polarity, that it pointed, with tolerable accuracy, towards the north."

364. Necklace on the Foremast carried away.—If unable to stand on the other tack, lower the topsail, run a hawser up to the topmast head, pass it round, pay down, hook the single blocks of a couple of luffs to bolts in the chains, bring to, snatch the falls, set the hawser up, and seize both parts together below the crosstrees. If the breeze is fresh, get a sail-tackle up in addition.

If unable to replace or repair the necklace, either fit a rope one, or bring together all the futtock shrouds that require securing, shackle them to a spare anchor-shackle or otherwise, set them up with a couple of up-and-downs hooked at the partners, and then frap them in to the mast aloft. The spurs through the links will hold the necklace on the opposite side to where it is carried away; and it is not probable, either that both necklaces on the mast will carry away at the same time.

365. Taking in Boom Mainsail.—In lowering away, mind and keep the jaws below the peak, or you will not get the sail down.

366. Stowage of Boom Mainsail.—Pass the leech along the gaff, taut in from the gaff and boom ends, with the

exception of a foot or two of slack, which the outer hand keeps back for a skin to stow the foremost part of the clew in, close under the gaff end : the slack sail is then passed forward, gathered up and stowed in the head cloths. When the gaskets are passed, the gaff is lowered with the sail just touching the boom.

A cutter's mainsail is frequently stowed on the foot.

367. Trimming Sails, short-handed.—If the wind draws aft, trim the after yards first ; if forward, the head yards.

368. Reefing Topsails in Stays.—According to the old song, you

"Away aloft" when the helm is put down ;
"Lower away the topsail," as the main yards flies round ;
"Trice up," and "lay out," and take two reefs in one ;—
For all in one moment this work must be done.
Then, man your head braces, your halyards, and all,
And as you "hoist away the topsails" you "let go and haul."

But a better plan is to "lower the topsails" when you "raise tacks and sheets," laying the yard square. Haul the main yard at the proper time, regardless of the men on the yard, provided the topsail braces are kept taut. Take the reefs in properly, "hoist the topsails" when the men are off the yards, and "haul of all" as usual.

The watch on deck and idlers reef the topsails, and watch below put the ship about.

369. Man Overboard.—*Plain sail, on a wind.*—Let go the life-buoy, put the helm a-lee, call the boat away, and direct the signalman not to lose sight of the man. Bring the ship up into the wind, to deaden her way (taking care not to

bring her round or to give her sternway), square the main yard, haul the mainsail up, and shorten whatever sail is necessary. The practice of going about, under these circumstances, is in many respects very objectionable. The cry of "man overboard!" in the most perfectly disciplined ship, is sure to be attended with some confusion at first, which becomes "worse confounded" when followed by the pipe of "hands about ship!" repeated and spun out by half a dozen boatswain's-mates. How much more quiet and simple is the order "square the main yard!" But the great and conclusive objection to it is, that, ten to one, the cause of it all will be lost sight of—in the literal sense; and, after getting the ship round and lowering the boat, *then* will arise the question of "Where's the man?" The signalman will say that he was last seen on the quarter, but as the quarter in the interval has been performing a circuit, the reply becomes anything but satisfactory. The boat in the mean time is probably vaguely striking out astern, and what with the hailing here, and answering there, anarchy in the end is pretty sure to reign triumphant. What a contrast does heaving-to present. The boat shoves off, unembarrassed by doubt; the signalman has had nothing to distract his attention; and should the former pull half a point wide, a flag over the stern will correct her course. At all times at night, and especially in the event of the life-buoy not being fired, the above remarks apply with still greater force.

It may be urged, that by going round, the ship is placed to windward of the man before the boat is lowered, and, therefore, she will reach him quicker than she would were the ship hove to on the original tack. But, granting that she

does reach to windward of her former position (although the main yard is squared in stays), where is the gain? Though the boat in this case pulls to leeward, it must not be assumed that, when the ship does not put about, her boat must pull to windward; for, as the man falls from the ship and is in her wake, the boat must necessarily have the wind and sea abaft her beam; and in either case the ship can bear up, if necessary, and get to leeward of her boat to pick them up.

Letter M means "pull to starboard," N "pull to port," and Q "keep as you are going."

Plain sail, before the wind.—Put the helm over, and come to the wind with the head yards aback, hauling up the foresail, and setting the spanker.

Studding-sails on one side.—Put the helm-a-lee, trip up the lower studding-sail, or let go the outer halyards, let fly the studding-sail tacks, brace up the after yards, and bring her to the wind with the head yards square. The studding-sails will fly before all, where they will be becalmed, and must be hauled down principally by the deck sheets. If you put up helm to take the studding-sails in to leeward, you run a most unnecessary distance away from the man; whereas, even in a fresh breeze, you run no risk by letting fly the tack of a weather studding-sail, for the sail flies to leeward clear of everything.

Studding-sails, both sides.—Round to with all dispatch, but in this case you must take everything in properly; for, if you let fly tacks and so forth, before the controlling gear can be manned, you will find "the more haste" to be "the less speed."

In each of the above cases, both quarter-boats, when possible, ought to be cleared away and lowered as speedily as possible, and the lifebuoy let go instantly, except in a very light breeze and when the man falls from forward, when you should hold on a little to come up to him, and then let go. Beware, too, of committing a blunder, which I once saw nearly perpetrated, of dropping the buoy upon the man's head.

Cases are not uncommon of men being drowned after they have been seen to get hold of the life-buoy; and, as on two occasions, I have seen it turn over with a man, it is very probable that to that cause such accidents are owing—the man being in an exhausted state and unable to get hold again. The proper way to hold on, is to put the feet on the rest at the bottom, one on each side, and throw the arms over the cross-piece; whereas an attempt to get *on* it will result in a capsize.

The circular cork life-buoys are so handy for *throwing* to a man, that is well worth while to carry one on each quarter for that purpose.

Boat's gripes, instead of being secured to an eye-bolt in the chains, should be set up to a strop with a thimble in it, passed through the eyebolt, and retained thereby by a slip-toggle and lanyard attached; which has therefore merely to be hauled upon to free the boat.

The steadying-lines should be of chain, with a hook on the ends; rope ones give, and are seldom hitched square. If they are too taut, an undue strain is brought upon the gunwale; and if too slack, the boat is not steadied.

To hoist a quarter boat up in a sea-way, there is no combination of "gil-guys" that you can invent equal to jackstays from the davits, set up to bolts at the water-line, A lizard is fitted to each, which travels up and down ; a turn whipped round the thwarts, and the boat run up, clear of the side, without further ado.

370.—TREATMENT OF THE APPARENTLY DROWNED.

The following directions are those issued by the Royal National Life Boat Institution.

I.

Send immediately for medical assistance, blankets, and dry clothing, but proceed to treat the Patient *instantly* on the spot, in the open air, with the face downward, whether on shore or afloat; exposing the face, neck, and chest to the wind, except in severe weather, and removing all tight clothing from the neck and chest, especially the braces.

The points to be aimed at are—first and *immediately*, the RESTORATION OF BREATHING ; and secondly after breathing is restored, the PROMOTION OF WARMTH AND CIRCULATION.

The efforts to *restore Breathing* must be commenced immediately and energetically, and persevered in for one or two hours, or until a medical man has pronounced that life is extinct. Efforts to promote *Warmth* and *Circulation*, beyond removing the wet clothes and drying the skin, must not be made until the first appearance of natural breathing ; for if circulation of the blood be induced before breathing has recommenced, the restoration to life will be endangered.

II.—TO RESTORE BREATHING.

TO CLEAR THE THROAT.—Place the patient on the floor or ground with the face downwards, and one of the arms under the forehead, in which position all fluids will more readily escape by the mouth, and the tongue itself will fall forward, leaving the entrance into the windpipe free. Assist this operation by wiping and cleansing the mouth.

If satisfactory breathing commences, use the treatment described below to promote Warmth. If there be only slight breathing—or no breathing—or if the breathing fail, and,—

To Excite Breathing.—Turn the patient well and instantly on the side, supporting the head, and—

I.—INSPIRATION.

Excite the nostrils with snuff, hartshorn, and smelling salts, or tickle the throat with a feather, &c., if they are at hand. Rub the chest and face warm, and dash cold water, or cold and hot water alternately, on them. If there be no success, lose not a moment, but instantly—

To Imitate Breathing—Replace the patient on the face, raising and supporting the chest well on a folded coat or other article of dress.

Turn the body very gently on the side and a little beyond, and then briskly on the face, back again, repeating these measures cautiously, efficiently, and perseveringly, about fifteen times in the minute, or once every four or five seconds, occasionally varying the side.

[*By placing the patient on the chest, the weight of the body forces the air out; when turned on the side, this pressure is removed, and air enters the chest.*]

II.—EXPIRATION.

The foregoing two Illustrations show the position of the Body during the employment of Dr. Marshall Hall's Method of Inducing Respiration.

On each occasion that the body is replaced on the face, make uniform but efficient pressure with brisk movement, on the back between and below the shoulder blades or bones on each side, removing the pressure immediately before turning the body on the side.

During the whole of the operations let one person attend solely to the movements of the head and of the arm placed under it.

[*The first measure increases the expiration the second commences inspiration*]

*** The result is *Respiration* or *Natural Breathing;* and if not too late, *Life.*

Whilst the above operations are being proceeded with, dry the hands and feet, and as soon as dry clothing or blankets can be procured strip the body, and cover or gradually re-clothe it, but taking care not to interfere with the efforts to restore breathing.

III.

Should these efforts not prove successful in the course of from two to five minutes, proceed to imitate breathing by Dr. Silvester's method, as follows :—

Place the patient on the back on a flat surface, inclined a little upwards from the feet ; raise and support the head and shoulders on a small firm cushion or folded article of dress placed under the shoulder-blades.

Draw forward the patient's tongue, and keep it projecting beyond the lips : an elastic band over the tongue and under the chin will answer this purpose, or a piece of string or tape may be tied round them, or by raising the lower jaw, the teeth may be made to retain the tongue in that position. Remove all tight clothing from about the neck and chest, especially the braces.

To Imitate the Movements of Breathing.—Standing at the patient's head, grasp the arms just above the elbows, and draw the arms gently and steadily upwards above the head, and *keep them*

stretched upwards for two seconds. (*By this means air is drawn into the lungs*). Then turn down the patient's arms, and press them gently and firmly for two seconds against the sides of the chest. (*By this means air is pressed out of the lungs*).

Repeat these measures alternately, deliberately, and perseveringly, about fifteen times in a minute, until spontaneous effort to respire is perceived, immediately upon which cease to imitate the movements of breathing, and proceed to Induce Circulation and Warmth.

2.—EXPIRATION.

The foregoing two Illustrations show the position of the Body during the employment of Dr. Silvester's Method of inducing Respiration.

IV.—TREATMENT AFTER NATURAL BREATHING HAS BEEN RESTORED.

To Promote Warmth and Circulation.—Commence rubbing the limbs upwards, with firm grasping pressure and energy, using handkerchief, flannels, &c., [*By this measure the blood is propelled along the veins towards the heart.*]

The friction must be continued under the blanket or over the dry clothing.

Promote the warmth of the body by the application of hot flannels bottles, or bladders of hot water, heated bricks, &c., to the pit of the stomach, the arm-pits, between the thighs, and to the soles of the feet.

If the patient has been carried to a house after respiration has been restored, be careful to let the air play freely about the room.

On the restoration of life, a tea spoonful of warm water should be given; and then, if the power of swallowing have returned, small quantities of wine, warm brandy-and-water, or coffee should be administered. The patient should be kept in bed, and a disposition to sleep encouraged.

GENERAL OBSERVATIONS.

The above treatment should be persevered in for some hours, as it is an erroneous opinion that persons are irrecoverable because life does not soon make its appearance, persons having been restored after persevering for many hours.

APPEARANCES WHICH GENERALLY ACCOMPANY DEATH

Breathing and the heart's action cease entirely; the eyelids are generally half closed; the pupils dilated; the tongue approaches to the under edges of the lips, and these, as well as the nostrils, are covered with a frothy mucus. Coldness and pallor of surface increase.

CAUTIONS.

Prevent unnecessary crowding of persons round the body especially if in an apartment.

Avoid rough usage, and do not allow the body to remain on the back unless the tongue is secured.

Under no circumstances hold the body up by the feet.

On no account place the body in a warm bath unless under medical direction, and even then it should only be employed as a momentary excitant.

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371. TOPMAST SHATTERED BY LIGHTNING.—Lash a light spar on each side of the mast, and unfid. Cut away these spars as you lower, lashing the topmast to the standing part of the hawser as it comes below the cap.

372. TOPSAIL ON FIRE.—*Fore Topsail.*—Bear up, haul down and stow the head sails, clew the topsail up, keeping it mast-headed, and cut foresail adrift. Then lower the topsail yard, and play upon the fire with engine and fire-buckets.

Main Topsail.—Take in all sail but jib and spanker, and bring the wind abeam.

With mizen topsail on fire, come to the wind.

373. Making up a Topsail for Bending.—To bring a sail to, furled, it is, of course, indispensably necessary to lighten the yard-arms as much as possible, and, consequently to throw all the weight you can into the bunt, which is kept up by the sail-tackle. Having, therefore stretched the head taut along the deck, roping downwards, and gathered back from the head, you bring the second reef up to it to form the skin; then lay the leech from the second reef-cringle to the reef-tackle cringle, along the head, gathering all the slack sail into the bunt; the reef-tackle bridle is left out, the cringle being brought up to the head cringle, and the clews carried in and laid out over the head on each quarter. The bunt-line toggles are brought in amidships, and seized to the head, so that, directly they are bent and a turn is taken with them, the sail-tack can be walked back, and the strop cut adrift. The bowline toggles being left out, the foot rope and slack sail gathered in amidships, the sail is rolled up and the gaskets are passed; and the clews, of which there is considerable drift left out for convenience in handling aloft, are passed from the fore side of the sail, underneath, and stopped up on the after side. Seize the strop on, and pass the head-earings in to the bunt, handy for laying hold of and passing out, when the sail is swayed up to the yard; and with heavy sails, it may be necessary to hitch the buntlines round the quarters, to keep them up.

374. Making up a Course.—Reef-tackle cringles are worked into the leeches a couple of feet below the head, to

which the reef-tackles are hooked for hauling out when bending, and shifting down to their proper cringle below the reef, when the earing is secured.

Stretch the head taut along, gather back, and bring up the second reef to form the skin; bring the leech taut along from the cringle, to which the reef-tackle is to be hooked; lay the leechline toggles out, and seize them to the head, and they will thus be in their proper places, close under the blocks, when the sail is hauled out; bring the buntline toggles close in amidships, drag all the slack sail into the bunt, and lay the clews out like those of the topsail; roll up, pass the gaskets, stop the head-earings up in a coil, seize the strop on and seize the head of the sail to the after part of the strop, that when the strop seizing is cut, the head of the sail may be kept up until brought to.

375. MAKING UP A JIB.—Stretch the foot of the sail along; passing a reeving-line through the hanks and lacing, and knot the ends together, after bringing up the bights of the head and lacing one by one; put a strop round every other cloth ,and it is ready either for stowing away or bending.

376. SHIFTING A TOPSAIL.—"Watch shift main topsail; "topsail clewlines and buntlines;" "away aloft;" "clew up and furl the sail." The sail-tackle in the meantime is cleared away, triced up, and hooked round the top-mast head, and its lower block hooked to a strop, which is seized round the bunt of the new sail.

When the old sail is furled, unbend the topsail sheets, clewlines, bowlines, reef-tackles, robands, and head earings:

hitch the buntlines round the sail, secure the bunt roband to them, ease in, and lower the sail down on the weather side by the buntlines.

While you have been doing this, the new sail has been swayed up, carefully kept on the right slue, until the second reef-tackles can be bent; then give the order—"haul out," and lower the bunt of the sail level with the yard. Secure the bunt robands and head earings, and bring the sail to; bend sheets, clewlines, robands, reef-tackles, and buntlines; clear away the gaskets, "let fall," "sheet home," and "hoist the topsail." If blowing hard, the requisite number of reefs should be taken in the new sail before it goes aloft, so that the reef beckets may be rove and toggled before letting fall.

The general rule for sending the sails up and down is:—if on a wind, the old sail down to leeward and before all, the new sail up to windward abaft the lower yard and before the topsail yard; if yards are square then both sails before all.

377. SHIFT MAINSAIL.—"Watch shift mainsail; "away aloft;" take in and furl the sail; unbend the reef-tackles and over-haul them down on deck; unbend buntlines, leech-lines, slablines, tacks and sheets—cast off head earings and robands, ease in, hitch the midship buntlines round the sail, and lower it by them.

The new sail is swayed up *furled* by the stay whip, and the yard arms are hauled out with the reef-tackles; this done, bring to the head of the sail, bend tacks and sheets, buntlines, leech-lines, and slablines; cast off the gaskets, let fall, and set the sail.

378. SHIFTING JIB.—Haul down, untoggle the purchase, cast off the tack and jib pendants, and bend the reeving-line, (kept fitted), either with a seizing passed between the eyes, to allow it to pass through the sheeve-holes, or with a small clasp hook fitted to the reeving-line. With a piece of sennit, kept seized on the stay under the sail, take a hitch round the stay, above the sail, to prevent it slipping down the stay in coming in, and to keep it in its place on going out. If blowing, a gasket must be passed round the sail. Bend a clew-rope from inboard to the clew, pull up the halyards, ease away the downhaul, and haul in on the clew-rope,—a hand at the boom-end lighting the stay through. When inboard, unreeve the stay, reeve it through the lacing of the new sail, and the downhaul through a couple of thimbles on the luff, take a hitch with the sennit, pull up the halyards, haul away the reeving-line and downhaul (the latter manned best,) easing the halyards and clew rope; toggle the stay and pull up on the purchase, shackle the tack, toggle the pendants, let go the downhaul, and hoist away.

The stay purchase is fitted with a strop, long enough to allow the bight of the stay to go through; a toggle is then put through the bight, and both parts of the stay are seized together. The halyards are fitted with a clasp hook, and the tack secured to a strop, which is passed down through the afterpart of the sheeve-hole, and toggled underneath the boom.

A jib-stay is sometimes seen fitted in two parts;—the shorter part, from inside the head where it sets up, reeving through the sheeve-hole in the boom, and having a thimble spliced into the end; while, to the lower end of the long

part, a clasp-hook is fitted, to take the thimble in the other part. Thus, it becomes unnecesssary to unreeve the stay through the boom ; for, directly the sail comes in on the forecastle, the two parts are unhooked, the long end hauled through the lacing, rove through the new sail, hooked to the short part, and hauled out.

A jib-stay is now almost invariably fitted to set up abaft the mast and with a slip at the boom end ; in this case a jib-stay outhole is usually fitted so as to haul the stay out again after the purchase abaft the mast has been well overhauled.

A T-chain may be used for shackling the pendants to the clew of the sail ; it is perfectly secure, and can be disengaged in a moment. The broad end of the large link should be bent up, to allow the centre of the cross bar to lie close up to it.

379. How to tell the Head from the Tack of the Sail in the Dark.—By the roping being on the port side, which is the case in all fore-and-aft sails.

380. Shift Jib-boom.—Strike the fore top-gallant mast get in the jib and flying-jib, unreeve the jib-stay, in flying jib-boom and leave it resting on the spritsail gaff and bowsprit shrouds. Hook the topmast stay-sail halyards to a strop round the end of the jib-boom, haul taut and keep them manned, haul taut the heel rope, ease up guys, back-ropes and jumpers ; slip the heel chain and crupper, ease the boom in by the heel rope, pulling up the staysail halyards as the boom

comes in ; leave the funnel and rigging resting on the spurs fitted to the bowsprit cap. A jigger on the forestay with a shifting strop round the boom is used to take the weight off the end as it is run in. In the meantime the new boom has been shouldered and carried forward, with its head resting on the knightheads. Shift the heel rope and jigger with shifting strop, from the old boom to the new ; haul away the heel rope when pointed and rigged, hook the staysail halyards as before, only keep easing them as the boom goes out. When out, on crupper and heel chain, fid the fore top-gallant mast, pull up back-ropes and jumpers, reeve and set up jib-stay, out flying jib-boom. Set the jib and flying-jib, cross the fore upper yards and set the upper sails.

381. SHIFTING A TOP-GALLANT MAST.—Furl the upper sails, stop the yard-ropes out, unbend the gear, and send the yards down. Land the royal yard in the top, unbend the yardrope, and unreeve it in the top, keeping the end at the cross-trees. As soon as the top-gallant yard comes down, carry the lower yard-arm aft and land it ; do not unbend the yard-rope as with the royal yard, but snatch the bight and run away with it. Sway on the mast-rope, the hands stationed at the rigging and stays clearing them away ; unfid and lower away. By this time, the end of the yard-rope is within a few feet of the mast-head, when a hand on the crosstrees checks it, with a stopper, and unreeves the rest by hand ; and when it is clear, lower away roundly, keeping the funnel fair as it comes off. As soon as the royal sheeve-hole comes below the cap, pass the lizard, securing it with a couple of half-hitches, and lower away through the lubber's hole ; land it on deck with the heel aft, unsnatch the mast-rope. In the meantime, the

new mast has been cleared away, laid alongside the old one, and *placed on the same slue*; so, that directly the mast-rope is unsnatched, it can be snatched again without any deliberation or fear of mistake; hitch the lizard, and sway away, easing the heel forward with a slip rope. Cast off the lizard as soon as the royal-mast-head is between the trestle-trees, sway, place the royal rigging and truck, reeve the royal yard-rope from aft forward, rounding down by a reeving line in the top; place the top-gallant rigging as the mast goes up, reeving the top-gallant yard-rope forward aft, as soon as the sheave-hole is above the cap. The reeving-line, which has been paid down on deck, as soon as it has been bent to the becket in the yard-rope aloft is run away with, and the yards are swayed aloft directly the fid is entered; the top-gallant rigging falls being paid on deck, and jiggers on the backstays all ready for pulling up at the same time.

Top-gallant masts fitted with snatches may be closed either with a slide to slip in a groove on each side of the sheeve-hole, by a strong iron pin, or with a couple of metal clasps across the snatch, which, by a pin behind each, are prevented from opening except towards each other, when, to free the yard-rope one must be close down before the other can be started. When there is not a lug, an eyebolt should be driven into the heel on the fore side of the mast, to catch the inside of the crosstrees, and prevent the mast being swayed through them, and also to bend an heel-rope to, by which to steady the mast at sea in going up or coming down. A pawl on the crosstrees fitting into a ratchet on the heel of the top-gallant mast is used as a preventer fid, and must be attended when fidding the mast. A hole may be bored, with advantage, about four feet below the royal sheeve-hole

for the lizard to reeve through, which allows it to be passed on sending the mast down, while the truck and rigging are being taken off, and the yard-rope unrove; and, in going up, to place any reeve the same without "avast swaying."

For expedition in bending and unbending the gear, fit the top-gallant yards with chain quarter-strops, and the quarter-blocks with clasp-hooks. By having the chock in the cross-trees, which confines the heel of the top-gallant mast, made to ship and unship, the mast can be sent down before all—to leeward, without the necessity for lowering the topsail.

382. SHIFTING A TOPSAIL YARD.—Take the sail in, unbend it, and haul it into the top. Pay down the sail tackle whip, trice up the sail-tackle, round it up and hook it to the quarter strop; unlash the quarter-blocks, cast off the standing part of the clewlines, (if cap clewlines are fitted, there is no standing part on the yard), and the standing part of the reef-tackles, unreeving the upper one, but allowing the lower one to go down with the yardarm, making a knot in the end; unsnatch top-gallant sheets, untoggle studding-sail tack blocks, and trice the booms up and down the topmast rigging, easing them in off the yard by a reef-earing. Hang the fly-blocks with jiggers to the topmast rigging; unshackle one tye-block and cast off the standing part of the other tye at the topmast head, round the tye down, and take a couple of half hitches with the end round its own part close down to the tye-block, then haul taut and take a turn with the halyards. Single the parral lashing, man the sail-tackle, attend the braces and sway away, easing the lower and topping on the upper lift; then lower away, unrigging the upper yard-arm in the top, and the lower one on deck.

Bend the top-bowline to the yard in order to send it down for the new yard, to guy it clear of the lower yard or top rim; if the yard is coming up to windward, the bowline must be dipped under the lower yard. As soon as the lower yard-arm is unrigged, land the goose-neck in a shoe fitted for it with a lanyard, and haul it along the gangway, where land it. Shift the sail-tackle and topsail-tye to the new yard, bend the bowline to the upper yard-arm (which is better, I think, than putting the guying-block of the sail tackle on—at least, when sending it up to leeward; but, when to windward, the bowline perhaps may be dispensed with, and the block used instead). To the lower yard-arm hook a luff from the fore or main rigging, according to the yard, to ease it forward or aft and keep it off the deck; sway up-and-down, and rig the yard-arms. Send a hauling-line down from the top for the end of the reef-tackle, as soon as it is rove through the lower yard-arm, which haul up and reeve through the block on the sail. Man the sail-tackle and halyards, led on opposite sides of the deck, and sway away when ready, taking through slack of lower lift. When the slings are above the cap, take a turn with the halyards, walk back the sail tackle and top on the lower lift, attending the braces. Pass out the earings and ends of the reef-tackles, haul out and bring the sail to. On quarter-blocks, send the booms out, bolt the tye-block, and secure the tye, sheet home, and hoist away.

The topsail tye is very seldom used, it is more usual to use a second small sail tackle or centre burton from the mast-head, which is hooked to the other quarter strop on the yard.

Send the yard up and down to windward, and if braced up then abaft the lower yard.

383. Shifting Main Topsail Yard in a Gale.—Lower the yard by hand, unbend the sail and send it on deck. Hook the sail-tackle, get the booms off the yard, and the gear unrove. Put two burtons on the main yard arms, over haul the starboard one up (supposing the yard to be coming down the starboard side), and hook it to a strop half way out on the starboard topsail yard-arm, and the port one up under the main stays, and hooked to the same place. Overhaul a guy (fore tackle falls, or a small hawser), from a leading block in each gangway, and bend them to the starboard yard-arm outside the burtons, and the main top-bowline to the starboard quarter. Man the sail tackle, port lift, burtons and guys, and sway away. Unrig the yard, let go the guys as they cease to become of use, land the yard, and use the same precautions in sending the new one up.

On such occasions, great difficulty is always found in steadying the yard to get the parral passed. To obviate this, before you sway across, hook a couple of jiggers from bolts in the cap to the slings of the yard, with which rouse the yard to.

384. A Sail Tackle—After use, requires over-hauling along the deck before stowing away, in order that it may reach the hatchway when triced up again.

385. Block of Sail-tackle comes out.—Rack both parts together below the pendant, send a snatch-block up to the mast-head, snatch the fall, cut the racking, and sway away again.

386.—Making up a Spanker.—Make it up on the head, doubling the leech in to bring it square with the head, then roll up.

387. Making a Topmast Studding sail up.—Lay the yard on deck with the fore side of the sail downwards, gather back from the head to form the skin, then bring the leeches and sail up to the yard a foot or two at a time, bighting the downhaul along with the outer leech equal to the whole length of the leech; pass the remainder along the sail to the inner leech, and leave it out with the sheets; then roll up. When setting stops are used, one is passed round the sail amidships, and another round the the outer yard-arm, confining the halyards.

388. A Lower Studding-Sail—Is rolled up on the head, and doubled in the length of the cover in which it is stowed.

389. Stowage of Sails.—When the sail-room will admit of it topsails and courses should be stowed with the bight doubled back between the yard-arms, which, when roused out lies in the square of the hatchway ready for whipping up, and all the time and labour usually lost in breaking out, when the sail is stowed the whole length of the sail-room, is thus avoided. As the arrangements of ships, below vary so greatly, it is useless to particularise any special disposition of the sail to facilitate removal.

390. Top-gallant Mast-rope.—The hauling part is rove through the lizard; for, if the standing part were used, the mast would be swayed up heel foremost.

391. The Standing Part—Is secured to that bolt in the cap which will keep the mast rope in a line with the sheeve. In the main, it will be the foremost bolt on the starboard side; and in the fore and mizen, the foremost bolt on the port side.

392 Top-gallant Mast gone short off.—Send a snatch-block up to the topmast head, snatch the yard-rope, and pull up,—which will bring the mast in; then lash the yard, unbend the yard-rope, send the mast first down, and then the yard.

393. Stowing a Jib.—In harbour, when you stow the head sails in a cloth, if covers are not used, gather up from the foot, using the after cloths of the leech to form the skin, a little slack sail being gathered up to cover the hanks, &c., at the head, and stopped close down, and the clew hauled up and equalized along the boom. At sea, get hold of the leech of the sail, gather it on the boom, and pass the gasket.

394. Marks and Deeps,—The marks are leather at 2, 3, and 10 fathoms, the two-fathom mark having a hole in it; white at 5 and 15; red at 7 and 17; blue at 13; and two knots at 20 fathoms. The intermediate fathoms are deeps.

395. Deep-Sea-Line.—Two knots at 20 fathoms, three at 30, and so on up to 100, when you commence again. Between every 10 fathoms there is a single knot.

Mark it, by passing the line through a strand of the lead-line, and take a knot in it; then pass it through the next strand and make another knot; and so on, as many as are required.

If a patent lead, there is no necessity for heaving to; but, if in deep water with a fresh breeze you want to get an up-and-down cast with a common lead, you will be obliged to do so; though, if not going very fast through the water, a luff up will in most cases answer the purpose.

When the lead is armed, carry it forward to the cat-head, pass the line forward from the weather quarter and bend it; place hands at intervals along the chains and quarter-boats, and let them coil up in their hands the quantity of line you require forward,—according to the depth of water. Let go, when ready; and as the line passes each man in succession, he calls out to the next,—"Watch there, watch!" should he not feel bottom. The quartermaster attends aft; marines hold the reel; and the line is snatched and walked in. Sounding with the patent lead, care must be taken not to check the line.

WALKER'S HARPOON SOUNDING MACHINE.—The first wheel makes one revolution in 30 fathoms, and the second one in 150.

Attach the sounding line to the Machine by the hole A, and a ship's lead to the lower hole B, by a looped or endless rope about three feet long.

Before throwing out the Machine (which must be done with plenty of rope), set the dials, by turning the button D, on the first dial, until the pointer is opposite the number 30, and the index of the wheel on the other side of the Machine points to 150.

On the lead entering the water, the action of the water lifts the catch up and turns the fan, which motion is communicated to the register wheels. Immediately the lead reaches the bottom, the fan ceases to

revolve and on the line being hauled in, the action of the water presses the catch down on the fan and locks it. The depth of the water in fathoms is shown by the register wheels.

396. VERY DEEP SOUNDINGS—In a steamer are taken with much greater facility from the bow, as it enables you to avoid getting over the line. This does not apply if Sir. William Thomson's Sounding Machine is used.

397. SIR WILLIAM THOMSON'S SOUNDING MACHINE—Enables soundings to be taken without stopping or reducing the speed of the ship. The line used for taking soundings is of thin steel wire, coiled on a drum, which when not in use is always kept in a tank of lime-water to preserve the steel wire from rust. To the end of the wire about a fathom of plaited rope is attached which is then bent to the lead, weight about 22lbs, a brass tube is also attached along the line just above the lead and in it is placed one of the prepared glass tubes, with its open end down. When ready for the cast, lift the brake of the drum, this releases the drum (but leaves a slight resistance to the wire running out,) which runs rapidly round till the lead strikes the bottom, this is immediately shown by the wire momentarily slackening, a small iron hook is held by hand over the wire as it is running out, by which means the slacking of the wire can be instantly detected, the brake is then applied, the counter read off as a check, and the line wound up. When the lead is up, take out the glass tube and by means of a scale supplied, read off the number of fathoms shown on it by the lowest part of the red coloured mark.

398. MARKING A LOG-LINE.—The length of the glass being 28 seconds, the length between each knot must bear

the same proportion to 28 as 3600—the number of seconds in an hour, does to 6076—the number of feet in a nautical mile. Therefore, as 3600 : 28 : : 6075 : 47·26; or 47 feet 3 inches.

A short glass, of 14 seconds, is used when the ship is going upwards of five knots; in which case, to give the true rate, the number of knots that are run out must be doubled.

The knot, not the line, is divided into tenths; and, to assist in calculating the distance that the last knot is over the traffrail, a single knot is placed midway between the knots. This of course is equal to five-tenths, but, when it is not brought exactly on the traffrail the difference is guessed at. *Stray-line* is allowed before the knots commence, to let the log-ship get clear of the eddy in the ship's wake, previous to turning the glass, and is proportionate to the height of the ship.

Log-lines should be wetted before marking, or correcting the marks, to allow them to take up, as they are always wet when in use.

Walker's Patent Harpoon Ship-log.—The part marked A and B in the above figure does not revolve as it passes through the water, but contains the wheel-work for registering the number of revolutions of the Rotator C, which is caused to revolve as it passes through the water, by the oblique position of the vanes D D. The angle of the vanes

is so adjusted to the wheelwork of the Register, that when the machine has passed through one mile, the finger of the first dial will have made one revolution; the finger of the dial No. 2 will have made one-tenth of a revolution, and index No. 3 will have made one-hundredth of revolution, or in other words, the first index goes round in one mile, the second index in ten miles and the third in 100 miles.

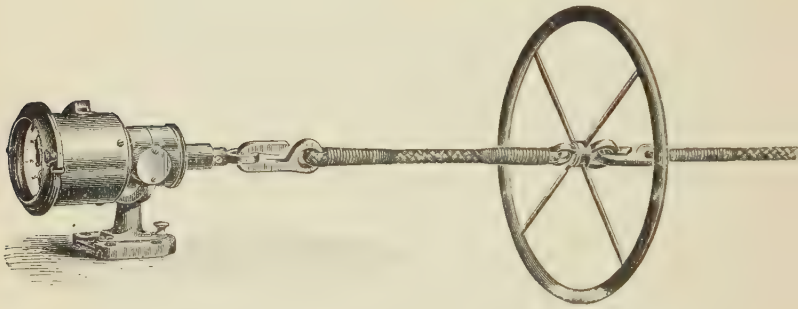
It will be seen that in this Log the Rotator and Register are combined, the Rotator being a continuation of the Register or part that holds the wheel-work. By this arrangement, not only is the machine made more compact, but the Rotator is protected from all front-end pressure, thus removing the principal cause of friction, and thereby enabling the Log to register *with equal accuracy at all speeds.*

Directions for use.—When the Log is to be used, connect it to the towline at M (the tow-line should be about 50 fathoms long), then place the first finger to 1, the second to 10, and the third to 100,

Before throwing the Log overboard, *be sure to cover the dials and the oil-hole* by turning the sliding-case E E, in order to prevent any dirt from getting into the Machine.

Walker's Cherub Log is very generally used. The register in this apparatus is fixed on to the ship in any convenient place. The log or rotator is attached by a long towing line to the register, the case of which contains a bell, which rings at short intervals as the log and line revolve, thus giving notice that the log is working. The advantage of fixing the register on to the ship is that it enables the distance run to be read off at any moment without having to haul in the log.

The governor wheel shown in the illustration acts as a flywheel to give steadiness and prevent any jerky action on the register.



399. A SQUALL CLOSE UPON YOU.—Haul the mainsail up, lower the topsails, haul the reef-tackles out, and the buntlines taut; and, if likely to head you, keep the ship away a little to be prepared. If the jib and spanker are set, take them in, and set fore topmast staysail.

Under ordinary circumstances in squally weather, the invariable cry is, "Hands by the top-gallant (or royal) halyards!" Accustomed to the order from long habit, it is repeated without reflection, from a vague notion of safety in the measure, and to be in accordance with rule in the event of anything going. As midshipman of a boat, you would not keep the sheet belayed, in breezy weather, and station a hand, in preference, to the halyards. Neither should you do so as officer of the watch, for you know that the heavier the squall is the firmer the yard will bind, and consequently, that letting go the halyards before the sheet is eased off will relieve nothing. For the future then (if you have hitherto

been misled, by custom, to the contrary), place hands by the lee sheets, and let the alarm of "Hands by the royal halyards!" henceforth die out with you.

400. TAKEN UNPREPARED.—Put the helm up and ease over the boom.

401. SETTING FORE TOPMAST STUDDING-SAIL IN A BREEZE.— See the yards properly secured, the lifts and trusses of the fore yard well taut, the topsail yard well in, a jigger on the topsail lift, and the burton well up; if necessary get a preventer brace on. As soon as the boom is out, and the heel-lashing well secured, martingale it down with a knot in the lower halyards; steady taut the boom-brace, keep away and trice to hand. When above the fore yard, get the tack out and hoist away. The best knot for the lower halyards is a short sheepshank.

402. TAKING IT IN.—Keep away, ease off the short sheet, lower the halyards and walk away with the downhaul. Do not start the tack till the yard is close down to the boom-end; nor rig in, till the sail is well below the fore yard. The deck sheet should be led through a block on deck, and well manned.

403. ROUNDING THE HORN IN THE WINTER MONTHS. —Bend a new suit of sails; reeve new braces and tacks and sheets if necessary; send topmast studding-sail booms on deck; caulk the ports in; fit the second reef of the courses reeve the topsail bunt-lines double, through a thimble seized into the foot, the standing part taken abaft the sail to the yard; fit leechlines to the topsails; secure the boom-boats well; top the quarter boats up, and secure them; get

stern boat inboard; unbend cables, fit standing preventer braces and trice them up to the quarters of the yards when not in use; seize strops to the parrals of topsail yards, to hook the rolling-tackles to, and, when all finished, you will be tolerably snug.

404. CLUBHAULING.—When a ship, working off a lee shore, has not room to wear, and is unable to tack, in consequence of the heavy sea, her only resource, in the event of not anchoring, is in clubhauling.

A hawser is passed out of the lee quarter port and secured to the ring of the lee anchor, the helm put down, and the anchor let go and veered on; the cable is then unshackled ready for slipping, and slipped when the ship cants the right way. When all safe, cut the hawser, or let it go, buoyed, if you intend at any time to return to recover the anchor.

405. GROUNDED.—Clear away kedge, or stream anchor, according to circumstances, and get ready for laying it out at once, whether you are likely to do without it or not. Heave all aback, watch the lead, to see if she goes astern; and, if on a sandy or muddy bottom, let every man take a shot in his hands, and sally together from side to side; by which means she may work herself loose. If of no avail, shove off with the anchor; if necessary, start your water; but should the wind be on shore, heave a good strain on the hawser or cable before doing so. If aground forward, and there is deep water astern, run the guns aft, and *vice versâ*.

406. WITH A RAPIDLY FALLING TIDE.—If unable to move the ship, you must prepare to shore her up, to prevent her falling over on her broadside; and therefore supposing

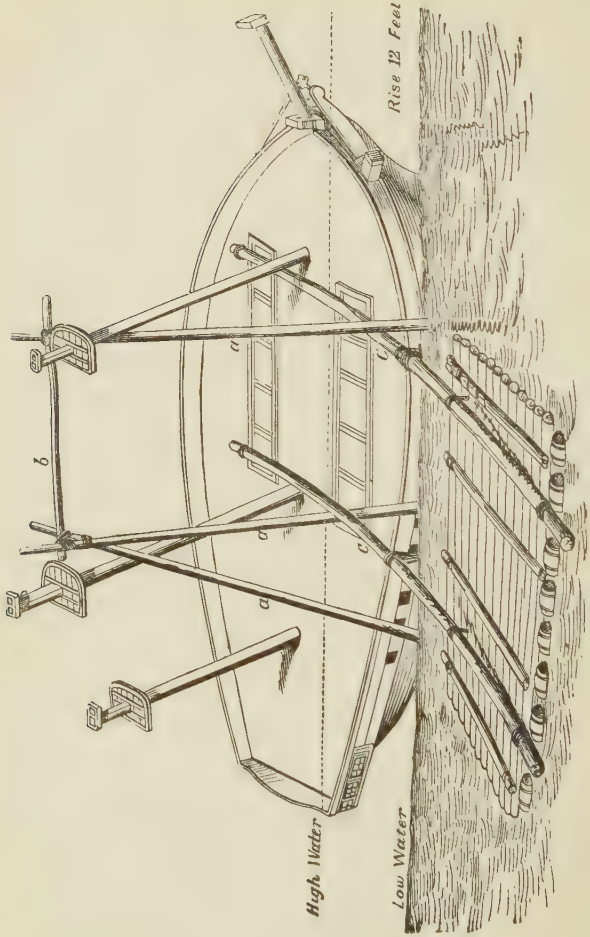
that on the port side the water is shoalest, give her a list over to port by running the starboard guns in, passing the shot over, &c. By means of the fore and main yards and stays, get the spare fore and main topmasts over the port side, with their heels weighted with shot to sink them ; bend fore-and-aft guys to the heels to place them, and let their heads take underneath the fore and main chains. As soon as she begins to settle down the right way, run the port guns in, close the ports, secure everything in its place, and send top-gallant masts on deck. In the mean time, lay the stream and kedge out on the starboard side, abreast of the fore and mainmasts, lead the hawsers in there, and heave well taut, for the purpose of steadying the ship and relieving the shores.

Be careful not to list her over more than is sufficient to prevent her falling over to starboard, for the shores are only intended to keep her upright, and not to support her weight, which must rest upon her keel and bottom.

407. SHIP FALLS OVER AND FILLS.— This happened to the "Samarang," 26, which ship was eleven days immersed in the Sarawak river, under the circumstances stated ; and the following description of the means adopted to raise her is derived from Sir Edward Belcher's "Voyage of the Samarang."

The crew and stores were landed as soon as possible, the ship cleared of her top-hamper, and before the next spring tide the following preparations were made :—

Three upright spars, *a*, *a*, *a*, were placed respectively abaft the fore chains, between them and the gangway, and on the fore side of the main chains— on the starboard side. The


Rise 12 Feet
a
b
c
c
c
High Water
Low Water

heads of the two latter were crossed ; and between them and the foremost one, a spar, *b*, was lashed, to keep them steady in their places.

To the head of these, heavy purchases were attached, with the lower blocks lashed to the bights of the breeching hawser, passed through the main-deck ports, and over the skid beams.

From the fore and main mast-heads, on the port side, tackles were taken to a cable ashore, which was secured to the trunks of trees.

On the starboard side, a powerful raft was constructed, of spars and water-casks, and across it were laid two trees, *c*, *c*, seventy feet in length ; their heels being lashed and cleated to the foremost and after skid-beams on the port side ; and to the end of these outriggers, which were lashed close down at low water, purchases were attached from the heads of the shores, to act in conjunction with the power of the raft.

These arrangements proved entirely successful. As the tide rose, on the date the attempt was made, the ship gradually assumed an upright position, and, being hove off to her anchor, was shifted to a safer berth.—July, 1843.

408. Carrying on.—The resistance by which a moving body is opposed, in passing through wind and water, varies as the square of its velocity ; and since the power to be exerted depends on the product of the resistance and the velocity, the power varies as the cube of the velocity. Hence to ascertain the alteration in the rate of sailing which will be

produced by increased or diminution of sail, say—

As the area of sail, then set,
Is to the area of canvas about to be set ;
So is the cube of the speed, then shown,
To the cube of the speed to be produced

And, in the present instance, the speed will be found to be only accelerated ·8 of a knot an hour.

If, then, so large an amount of sail as sixteen hundred yards, equal in this case to the main topsail and fore and main top-gallant-sails, produce so small a result ; how little except in emergencies, will a smaller amount of canvas cracked upon a ship to the endangering of the spars, compensate for the trival gain in speed attained at such a hazard.

As a general rule, therefore, the moment a spar complains, in with the sail ; and thus, knowing the futility of pressing a ship, you will be relieved from those unpleasant moments of hesitation, when, tempted to hold on against your half-formed convictions to the contrary, you stand, with anxious glance aloft at every lurch and bound, the image of hapless indecision.

409. UP SCREW.—Lifting screws are fitted in a banjo frame, and require to be slewed with the blades up and down before raising. Reeve the screw pendants and falls ; the pendants are rove by reeving lines, which are always kept rove through the sheeves in the banjo, and crosspiece, or shear-head, as the case may be ; the standing part of the pendants are secured on deck with a round turn, half-hitched, and the ends seized down. Deaden the ship's way if ne-

cessary; man the falls equally, walk away steadily, when high enough, put in the chocks, walk back the falls and unreeve the pendants.

To get the screw down reverse this operation.

410. DISCONNECT THE SCREW.—This is done in the screw passage generally, by removing the connecting bolts; if you are going fast, the speed should be reduced before disconnecting.

Few screws will commence to revolve under a speed of four or five knots, it is therefore a good plan if on a wind to keep away a little after disconnecting, and so start the screw.

In a feathering screw the blades can be turned so as to offer very little resistance to the water.

411. BACKING ASTERN—Will, if there is any wind, always bring the ship's stern up to it, and of course throw her head off the wind.

412. TWIN SCREWS—Are right and left-handed, so that when working they revolve in opposite ways, and do not affect the steerage; their advantages over the single screw are that the ship can be turned in a smaller space, though not quicker, also that you still have the power of steaming with one if the other should foul, or its engines break down. The disadvantages are, that from their position they are more liable to be fouled, and that under canvas they impede the ship more than a single screw. Ships fitted with twin screws, when cruising with a squadron, should never back or stop one screw without the other, and both screws should,

when moving, make the same number of revolutions, not only for your own sake, but for the benefit of your next astern.

413. COMING IN FROM A LONG CRUISE.—A day or two before getting in, have the paint-work well scrubbed and cleaned, especially under the bows and chains ; studdingsail booms sent on deck and lightly planed over, then sent up and the ends painted. Chafes on boats and lower booms touched up, lizards and ladders ready for going on, and, if in fine latitudes, ship's side painted as low down as possible, having first been well scrubbed. Masts, fly blocks, &c., scraped, and chafes on rigging blacked. The morning before going in, holystone decks, scrub windsails, boats' gear, and sails. Sling clean hammocks the evening before, if they at all require it. Accommodation-ladder holystoned and in order; top-gallant masts fresh stayed, and squaring marks of lifts, braces, and buntlines looked to. As you near the port, down hanging-mats, off sea and up harbour gaskets, or, if used on the head of the sail, they will require blacking afresh ; single the tacks and sheets, off spans of topsail buntlines, see cables and anchors clear, buoy-rope ready and buoy blacked, chains to rights, and nothing hanging overboard. If coming to, under sail, on approaching the anchorage, turn the hands up, shorten sail, not forgetting to have a boat's crew warned to shove off and square yards directly you come to ; upper-deck sentries ready for going on, and stage party and stage ready with paint, &c., for going directly the sails are furled. A harbour furl of the head sails, if they are not wanted ; then, if the topsails are sufficient to come to under, "Fore clew-garnets, top-gallant and royal clewlines,

studding-sail downhauls;" "Shorten sail." Let go the weather anchor when you reach your position, veer away, and stand on till far enough, when clew up the topsails and let go the other anchor, giving her a sheer over the right way so as not to cross the cables, and hold on till you heave in, to avoid fouling the anchor. Furl sails and moor ship.

In an open roadstead, moor with open hawse to the prevailing wind, if there is a predominating one; otherwise, with open hawse to seaward. If in a tideway, lay the anchors for the flood and ebb, up and down the river.

Let me here recommend the plan of squaring yards with flags, as it possesses so many advantages over the general method. It saves the lungs of the boatswain, allows him to go to any distance from the ship, is not liable to be misunderstood, is far more expeditious, and, in a close harbour, saves all the intolerable bawling that follows the close of any exercise with the fleet.

Three small flags are required, bent to short staves,—red, white, and blue. Red stands for main; white, fore; blue, mizen. Boatswain faces the ship, and holds the flag on the side the yard requires to be topped. For lower yards the flag is held horizontal; top sail yards, flagstaff perpendicular; top-gallant yards, he stands up in the boat, and holds the staff at an angle of 45° royal yards, flagstaff at the same angle, but the arm lowered. Masts can be stayed in the same manner. The flag need not be kept up all the time the yard is being topped on; but it can be lowered directly the boatswain's mate on the jib-boom end, holds his hand up to show that he understands it, and should be waved when the yard is square.

414. MANAGEMENT OF CHRONOMETERS.—We will suppose that you anchor at Hong Kong, November 30th, 1900, with the chronometers run down; that they are numbered 2103, 742, and 254, and that their hands point respectively to 8h. 17m. 10s., 3h. 57m. 43s., and 9h. 30m. 22s. You therefore wind up one, 2103, shortly before 4 p.m., (time of place), by which you will set it to approximate Greenwich time (Hong Kong being about 7h. 27m. east of Greenwich); but as it is considered injurious to touch the hands of chronometers, and with many you are unable to get at the face to move them, you wait till it is 9h. 30m. by 2103, and then wind up 254; and, when nearly 4h. by these two, wind up the third, 742; thus, for the sake of convenience in computing their differences, bringing them all near to each other.

On the following morning land with one, 2103, and ascertain its error by A.M. sights, or equal altitudes (Inman, art. 253—260), taking several sets. Repeat this on the succeeding day; and, if these agree with the former, and no inaccuracies are detected, an interval of a week at a time may elapse between the subsequent observations for rate.

Prepare a "CHRONOMETER JOURNAL" according to the following form, in which you note down the comparisons taken every morning when you wind up, and by which you see how the watches are going with each other.

The error of 2103 from the 1st to the 21st is that found directly from sights; and the error of the other chronometers, in the adjoining columns, is obtained by applying the comparison; thus—

Dec. 1900.	TIME BY 2103.	TIME BY 742.	2103. s 742.	Daily Difference.	TIME BY 2103.	TIME BY 254.	2103 s 254	Daily Difference.	TIME BY 742.	TIME BY 254.	742. s 254	Daily Difference.
	h. m. s.	*h. m. s.*	*sec.*	*sec.*	*h. m. s.*	*h. m. s.*	*m. s.*	*sec.*	*h. m. s.*	*h. m. s.*	*m, s.*	*sec.*
1 ...	12 16 0	12 16 21	21	—	12 16 20	11 55 20	21 0	—	12 17 0	11 55 38	21 22	—
2 ...	12 29 0	12 29 22	22	1	12 29 20	12 8 13	21 7	7	12 30 0	12 8 30	21 30	8
3 ...	12 4 0	12 4 23	23	1	12 4 20	11 43 5	21 15	8	12 5 0	11 43 22	21 3	8
4 ...	12 15 0	12 15 24	24	1	12 15 20	11 53 58	21 22	7	12 16 0	11 54 13	21 47	9
5 ...	—	—	—	—	—	—	—	—	—	—	—	—
6 ...	—	—	—	—	—	—	—	—	—	—	—	—

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NOTE.—For convenience of reference the Chronometers are invariably distinguished by the letters A. B. C. &c. A being the letter usually allotted to the Standard Chronometer.

On the opposite page keep a Table of "RATES AND ERRORS" for bringing up the time daily as under:—

Dec 1900	2103 — Slow	Daily Rate — Losing.	742. — Slows	Daily Rate. — Gaining	254. — Fast.	Daily Rate — Losing	Hour of Winding	REMARKS.
	m. s.	*sec.*	*m. s.*	*sec.*	*m. s.*	*sec.*		
1	4 30	—	4 9	—	25 30	—	8. A.M.	
2	4 32	2·0	4 6	3·0	25 25	5·0	,,	
8	4 47·5	2·5	3 46·6	3·2	24 52·4	4·7	,,	By sight at Kowloon Pt., Hong Kong. Lat. 22° 17′ 6″ N., Long. 114° 10′ 12″ E.
14	5 5·1	2·7	3 24·8	3·4	24 28·9	4·7	,,	
21	5 24	2·7	2 59	3·5	23 56	4·7	,,	
22	5 26·7	,,	2 55·5	,,	23 51·3	,,	,,	Sailed from Hong Kong.
23	5 29·4	,,	2 52	,,	23 46·6	,,	,,	
24	5 32·1	,,	2 48·5	,,	23 41·9	,,	,,	Exercised firing at a target.

NOTE.—For convenience of reference the Chronometers are invariably distinguished by letters A. B. C. &c., A, being the letter usually allotted to the Standard Chronometer.

DECEMBER 1st.

	m.	*s.*		*m.*	*s.*
2103.....	4	30 Slow of G.M.T	2103.....	4	30 Slow of G.M.T.
Comp.. .	0	21 Fast.	Comp...	21	0 Slow.
742.....	4	9 Slow of G.M.T.	254.....	25	30 Slow of G.M.T.

The daily rate on the 8th, 14th, and 21st, is found by dividing the difference between the error on those days, and the error found on the 1st by the number of days in the interval; the error found on the 1st being used in each case, because the longer interval gives the better average.

After the 21st, when the last rate was obtained, the error is brought up by applying it daily; retaining it until you have an opportunity of correcting your rates again at a place whose position is fixed, unless, by scanning the daily differences, you are led to suppose that the rate of any watch is altering, or has jumped in a differate rate, when you alter the rate accordingly.

When at sea, find once a week the Greenwich time by all three watches; and repeatedly do so, on approaching land, scrutinizing the longitude given by each. But, as you cannot practically catch them all at the same instant, without an observer to each, you find the time shown by each watch at the time of sights, by applying the comparisons; for example—

A.M. MARCH 2nd, 1900.

	h.	*m.*	*s.*	
2103.....	4	10	20	Time observed for sights.
		7	39·5	Error, fast.
	16	2	40·5	G.M.T. (1st).

742				254			
h.	*m.*	*s.*		*h.*	*m.*	*s.*	
4	10	20	Time shewn by 2103.	16	10	20	Time shown by 2103.
	+ 21		Comp. between 2103 [and 742.	3	21	0	Comp. between 2133 [and 254.
4	10	41	742 at time of sights.	12	49	20	Time shown by 254.
	7	41·2	Error, fast.	3	13	23·8	Error, slow.
16	2	59·8	G.M.T.	16	2	43·8	Greenwich Time.

You would, therefore, use the mean of 2103 and 254, seeing that they differ but three-quarters of a mile, and would reject 724, which differs $4\frac{3}{4}$ miles from 2103, and four miles from 254, unless you had very strong ulterior reasons for relying upon it.

If you have only two chronometers, and you find, when bringing them up weekly, that the longitudes differ, take the mean, unless you have good reason to prefer one to the other.

In comparing more than three chronometers, select one for a standard, and compare each of the others with it, instead of with each other.

CHAPTER XI.

SIGNALS.

415.—SIGNALS.—There are four methods of conducting signals, viz : Flags, Semaphore, Flashing (by sight or sound), Guns.

The electric semaphore can be used at night in exactly the same manner as during daylight

Flashing Signals—are made either by day or night, they are made by the motion of any one object ; in some cases the object is caused to appear and disappear ; in others, it changes its position, so that one position denotes the appearance and the other the disappearance of the object. The signals made at night by the exposure and obscuration of a single light is an example of the first, while the method of flashing signals by the waving of a flag on a staff is an example of the second.

The flashing system can also be used in a fog, long and short sounds on a foghorn, siren, or whistle, denoting the long and short flashes.

The long flash ought to be three times as long as the short flash, the pause between each complete sign being equal to a long flash.

Gun Signals—Are made by combining various numbers of guns fired, with different intervals of time between the reports.

416. LINE OF BEARING—In the old sense meant that

the fleet were sailing on a bearing, which, if they hauled their wind, or tacked together, would put them in "line of battle," or, as it is now termed, "line ahead." It may be generally understood to mean that ships are on a bearing from each other; into which they have been thrown by altering course together.

The following remarks in connection with steam evolutions may perhaps be found of some interest to young officers who have not had much experience with large squadrons.

The speed of a fleet steering a course is limited to that of its slowest ship.

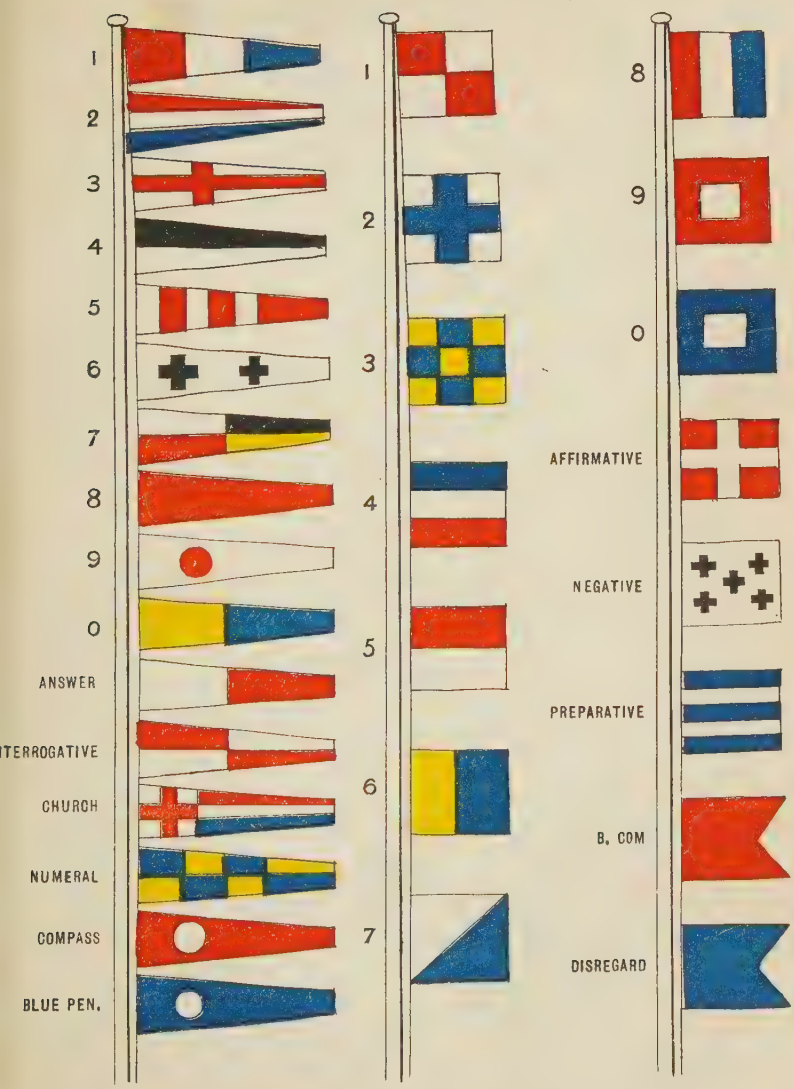
The speed at which a fleet can manœuvre must be still less, to ensure the slow vessels the power of preserving their stations with facility.

At a given speed, the rapidity with which an evolution involving a large alteration of course, can be affected, will be governed by the ships of the most inferior steering power.

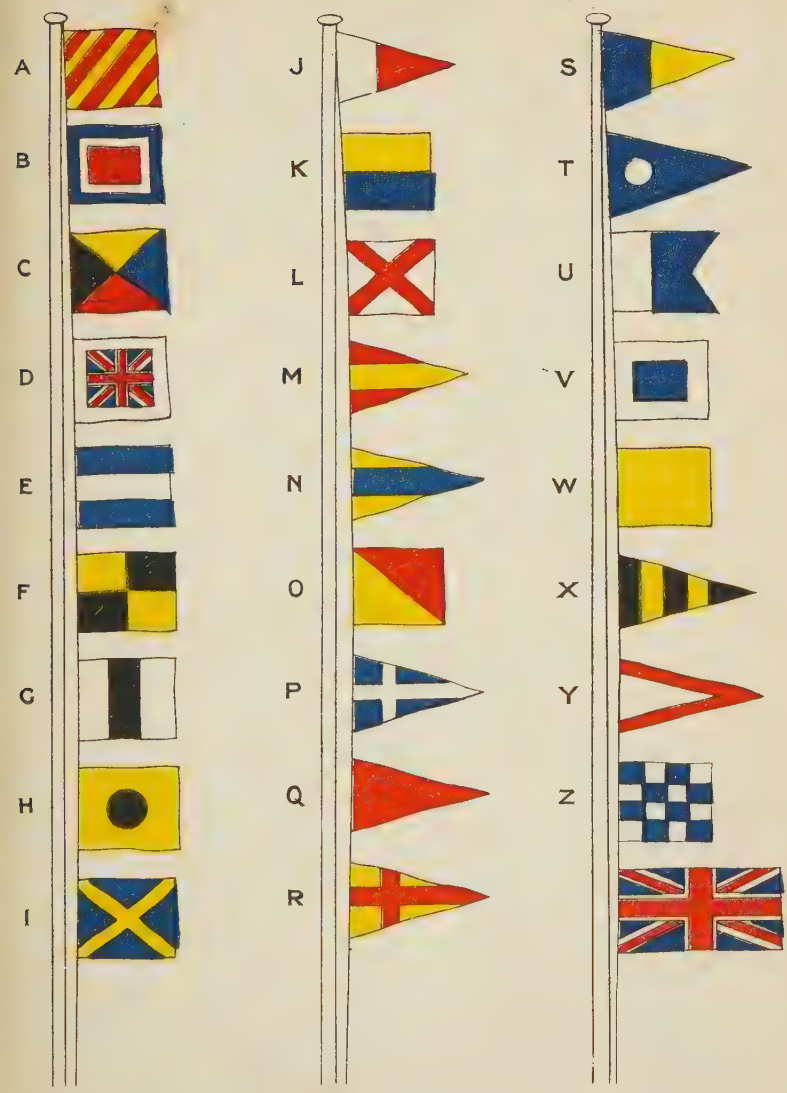
From the foregoing can be gathered the great importance of the ships composing a fleet assimilating each other, both in speed and handiness.

Accurate station can be best preserved by making moderate, not extreme, changes of speed or course, which latter renders the station of the ships following you most difficult to keep, besides increasing the expenditure of fuel.

Before commencing steam evolutions, each vessel should be aware of the revolutions of the screw per minute, required by her to go the same speed as any other ship whose revolutions are known; this can be best done by obtaining a co-efficient of revolutions.

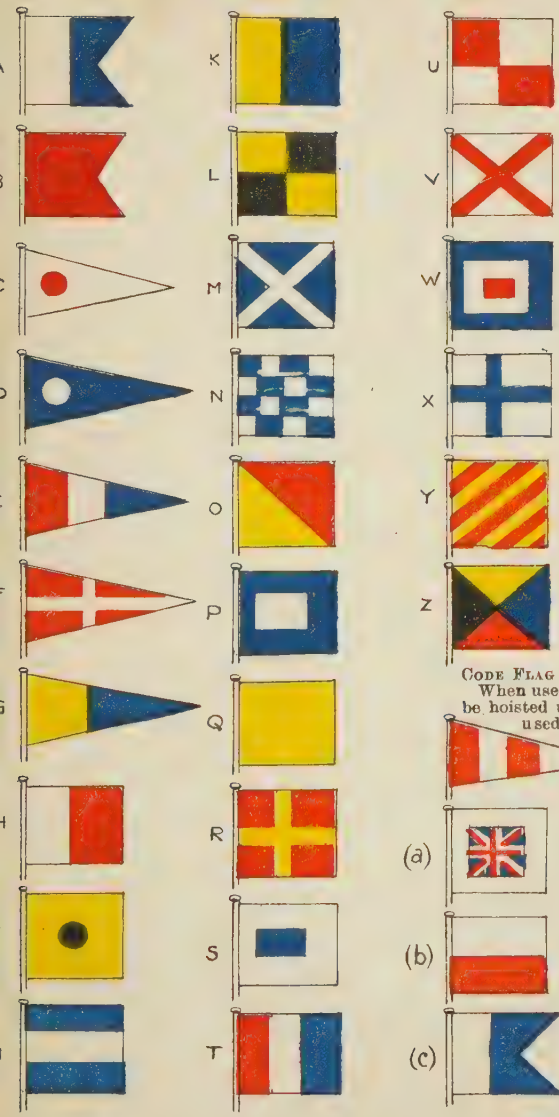

PENDANTS.
NUMERAL AND SPECIAL FLAGS.
1
2
3
4
5
6
7
8
9
0
ANSWER
INTERROGATIVE
CHURCH
NUMERAL
COMPASS
BLUE PEN.
1
2
3
4
5
6
7
8
9
0
AFFIRMATIVE
NEGATIVE
PREPARATIVE
B. COM
DISREGARD

ALPHABETICAL FLAGS.



INTERNATIONAL CODE OF SIGNALS

FLAGS AND PENNANTS.



CODE FLAG & ANSWERING PENNANT.
When used as the Code Flag it is to be hoisted under the Ensign. When used as the Answering Pennant to be hoisted at the mast-head or where best seen.

SINGLE FLAGS USED BY BRITISH SHIPS HAVING SPECIAL SIGNIFICATIONS.

A general comparison of the angle of helm that can be given, with the diameter of the circle described, will be found most useful.

In the presence of an enemy, owing to the great uncertainty of signals being seen and correctly interpreted, and in the absence of a pre-concerted plan of attack, it is improbable that any but the most simple and easily executed manœuvre would be attempted; the more complicated may be regarded rather as affording an exercise necessary to the attainment of skill and precision in handling the ships, than for their elaborate performance in the face of a hostile fleet.

Smokeless coal is an absolute necessity in a fleet.

417. Tacking in Succession.—The leading ships put their helm down together, the other ships at the moment that will allow them to fetch into the wake of their next ahead when on the other tack.

418. Wearing in Succession.—Your ship being well round on the other tack, the after yards should be kept in until the last ship in the line has passed, lest, by coming to the wind too soon, you do not allow room for the other ships to pass ahead of you; whereas, with the after yards well in you are all ready for keeping away in case of accident.

419. Fog at Night.—Use the fog horns, or if under steam, the steam whistle; stop all unnecessary noise, note the last bearing and distance of the Admiral, and your next ahead; have a watch with second hand, and a slate ready to note any gun signals the Admiral may make; avoid making any sudden changes of speed if possible.

420. The Admiral's Motions—Should at all times be immediately followed, unless ordered to the contrary.

SECTION III.

Chapter XII.

ANCHOR WORK.

421. Manufacture of Chain Cable.—Chain cables are made from iron bars which have been twice worked in the Forges and Mills, free from any admixture of steel, and of a highly fibrous character. The iron is inspected by an Overseer, and samples taken by him are subjected to the tests stated in the Admiralty specifications.

After being approved, the bars are passed on to the chain factory, where they are first sheared into the required lengths. The bars are cut diagonally in order to form the scarfs. The pieces are next heated to a red heat and turned by machinery into the shape the link is to take, and passed on to the smith who welds the link and inserts the steel stud.

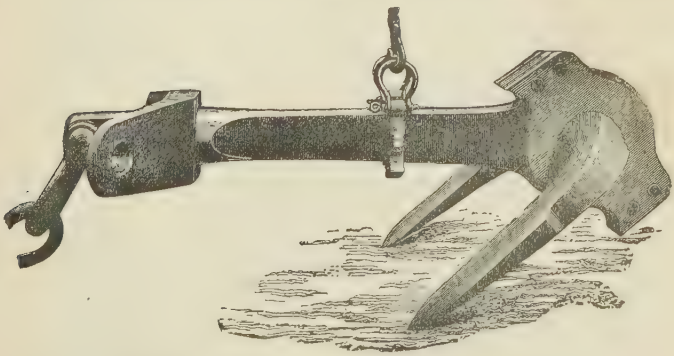
When a length is complete with end links, shackles, and intermediate links, three links are selected and cut out by the Overseer, and taken to a machine licensed for testing by the Board of Trade, and tested in his presence to destruction. The result of this test must be at least 50 per cent. more than the proof strain specified by the Admiralty After the test has been satisfactorily made, the length is joined up, every link is minutely examined and cleaned and the complete length dispatched to the Test House to be finally tested to the Admiralty Proof strain, after which it is ready for delivery to the yard.

From notes kindly furnished by the Earl of Dudley's Round Oak Works, Brierley Hill.

422. ANCHORS.—The modern system of Naval construction has necessitated an alteration in the form of Anchor originally in use in the Service, and has led to the almost universal adoption of the "Two Armed Holding Anchors."

The principal advantages are, the stowing flat on the vessels' bows consequently lying clear of the line of fire, clearing the ram when weighing, and the decreased risk of fouling the cable owing to their being no upright stock. Experience seems to show that their holding power is equal to that of the old Admiralty pattern anchor, although for some time after their introduction into the Service there was considerable prejudice against them. There are various patterns in use such as Martin, Baxter, and Inglefield and Lennox, but they differ merely in details.

The annexed sketch shows an improved Martin's Anchor.



The principal improvement consists of a simple but effective arrangement of the head of the Anchor, which acts as a lever on the flukes, compelling them to take the ground immediately the strain is applied through the cable.

The head is fixed at right angles on the flukes, and moves freely round the end of the shank. The elongation of the head on each side is peculiarly shaped to act as tipping points, and this part resting on the ground when the Anchor is down, the superincumbent weight causes it to bite firmly, whether in hard or soft ground; and immediately the strain is applied, the resistance of the ground to the tipping points compels a rotatory movement and turns the flukes into the ground.

It is absolutely weldless The flukes are composed of one solid forging, the shank of another, and the severe holding strains are entirely confined to *these two solid forgings* without the intervention of bolts, pins, keys, cotters, &c.

The following advantages are claimed for all "Two Armed Holding Anchors."

It is not liable to *foul or get fouled*, even in steaming ahead of or around it, and *trips* with ease.

It can be *catted* and *fished* with ease and rapidity.

Stows flat alongside the ship and is always ready for use.

No part projects above ground, by which the ship's bottom can be injured in shallow water, or whereby the chain can foul the Anchor.

Its *reduction in weight* and easy working throws considerably less strain on the ship's bows and forecastle.

Its shank is so short that it soon *clears the water*, and the ship can proceed without waiting for fishing and catting.

Nothing projects beyond the ship's side, and in the event of a collision, or one ship fouling another, the great mischief of hooking the rigging spars or bulwarks, which prevents the ships clearing each other, is avoided.

It can also be *taken to pieces* and *stowed away*, although it stows remarkably well without resorting to that course.

On a vessel of war it is out of the line of fire and cannot be displaced by the shock of ramming.

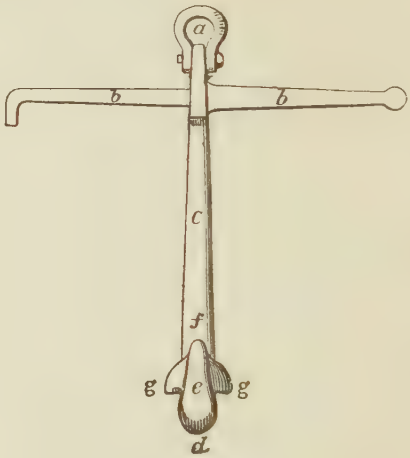
In the older pattern of these anchors a grave defect was practically demonstrated by experience, that under certain conditions, such as paying out too little cable, &c., it did not act as quickly or efficiently as desirable.

On one occasion a diver was sent down after a vessel had been lying at anchor at Spithead, and reported that the flukes were above the ground although the head was buried.

Stockless Anchors;—have been to a certain extent introduced into the Merchant Service and in some cases to foreign men-of-war. The operations of "catting" and "fishing" are dispensed with and the anchor work consequently simplified. The form of the anchor, the formation of the seating and enlargment of the mouth or entrance of the hawse pipe are such, that the anchor can be hove direct into the hawse pipe, a recess is arranged to receive the flukes so that the anchor houses itself automatically within the skin of the ship on being hove up.

423. PARTS OF AN ANCHOR.—In the old "Admiralty pattern" anchor here shown, the stock reeves through the shank and is secured by a forelock; this pattern is generally used for Stream, Kedge and Boats' anchors.

a Shackle or Ring.
b Stock.
c Shank.
d Crown.
e Arm.
f Pea. } Fluke
g Palm. }



424. TESTING OF ANCHORS.—All Steel Anchors such as Martin's and others of a similar construction are subjected to the following tests:—The anchor to be tested is raised about 12 ft. from the ground and then allowed to drop square on to a large iron slab, it is then raised again crown downwards, iron blocks are placed underneath, and the anchor dropped so that the arms fall fair on the blocks. It is then slung in chains, and hammered all over to ascertain if it is perfectly sound, and after which it is tested for strength, the flukes being held firmly in position while a strain is applied to the ring of the anchor, it should be able to stand a strain according to the Table of Proof tests.

The tests for wrought iron anchors differ slightly from the above. The fire proof test is first applied, it consists in making the anchor red hot, and then carefully examining it to ascertain if there is any flaw in the welding, the anchor is then tested for strength, the flukes being secured, and the strain applied to the ring in a similar manner as with steel anchors.

TABLE SHOWING THE TEST OF ANCHORS (IN TONS) PROPORTIONED TO THEIR WEIGHT (IN CWTS).

The strain is applied on the arm or on the palm at a spot which, measured from the extremity of the bill, is one third of the distance between it and the centre of the crown.

Wgt.	Test.	Wgt.	Test	Wgt.	Test.	Wgt.	Test.	Wgt.	Test.
cwt.	tons.	cwt	tons.	cwt.	tons.	cwt.	tons.	cwt.	tons.
120	$74\frac{3}{4}$	95	$65\frac{3}{8}$	70	$53\frac{3}{4}$	45	$39\frac{1}{4}$	20	$20\frac{3}{4}$
119	$74\frac{3}{8}$	94	65	69	$53\frac{1}{4}$	44	$38\frac{5}{8}$	19	$19\frac{7}{8}$
118	74	93	$64\frac{1}{2}$	68	$52\frac{5}{8}$	43	$37\frac{7}{8}$	18	19
117	$73\frac{5}{8}$	92	64	67	$52\frac{1}{8}$	42	$37\frac{1}{8}$	17	$18\frac{1}{4}$
116	$73\frac{1}{4}$	91	$63\frac{5}{8}$	66	$51\frac{1}{2}$	41	$36\frac{1}{2}$	16	$17\frac{3}{4}$
115	$72\frac{7}{8}$	90	$63\frac{1}{4}$	65	51	40	$35\frac{3}{4}$	15	$16\frac{1}{2}$
114	$72\frac{1}{2}$	89	$62\frac{3}{4}$	64	$50\frac{1}{2}$	39	$35\frac{1}{8}$	14	$15\frac{3}{8}$
113	$72\frac{1}{8}$	88	$62\frac{1}{4}$	63	50	38	$34\frac{1}{2}$	13	$14\frac{3}{4}$
112	$71\frac{3}{4}$	87	$61\frac{7}{8}$	62	$49\frac{1}{2}$	37	$33\frac{3}{4}$	12	$13\frac{7}{8}$
111	$71\frac{3}{8}$	86	$61\frac{1}{2}$	61	$48\frac{7}{8}$	36	$33\frac{1}{8}$	11	$12\frac{7}{8}$
110	71	85	61	60	$48\frac{3}{4}$	35	$32\frac{3}{8}$	10	12
109	$70\frac{5}{8}$	84	$60\frac{1}{2}$	59	$47\frac{3}{4}$	34	$31\frac{5}{8}$	9	$11\frac{1}{8}$
108	$70\frac{1}{4}$	83	60	58	$47\frac{1}{4}$	33	$30\frac{7}{8}$	8	$10\frac{1}{8}$
107	$69\frac{7}{8}$	82	$59\frac{1}{2}$	57	$46\frac{5}{8}$	32	$30\frac{1}{8}$	7	$9\frac{1}{4}$
106	$69\frac{1}{2}$	81	59	56	46	31	$29\frac{3}{8}$	6	$8\frac{1}{4}$
105	$69\frac{1}{8}$	80	$58\frac{1}{2}$	55	$45\frac{3}{8}$	30	$28\frac{5}{8}$	5	$7\frac{3}{8}$
104	$68\frac{3}{4}$	79	$58\frac{1}{8}$	54	$44\frac{3}{8}$	29	$27\frac{7}{8}$	4	$6\frac{3}{8}$
103	$68\frac{3}{8}$	78	$57\frac{5}{8}$	53	$44\frac{1}{4}$	28	$27\frac{1}{8}$	3	$5\frac{1}{2}$
102	68	77	$57\frac{1}{4}$	52	$43\frac{3}{8}$	27	$26\frac{3}{8}$	$2\frac{9}{112}$	$4\frac{9}{16}$
101	$67\frac{5}{8}$	76	$56\frac{3}{4}$	51	43	26	$25\frac{5}{8}$	2	$4\frac{1}{2}$
100	$67\frac{1}{4}$	75	$56\frac{1}{4}$	50	$42\frac{3}{8}$	25	$24\frac{3}{4}$	$1\frac{54}{112}$	$3\frac{15}{16}$
99	$66\frac{7}{8}$	74	$55\frac{3}{4}$	49	$41\frac{3}{4}$	24	$23\frac{7}{8}$	1	$3\frac{3}{8}$
98	$66\frac{1}{2}$	73	$55\frac{1}{8}$	48	$41\frac{1}{8}$	23	$23\frac{1}{8}$		
97	$66\frac{1}{8}$	72	$54\frac{3}{4}$	47	$40\frac{1}{2}$	22	$22\frac{3}{8}$		
96	$65\frac{3}{4}$	71	$54\frac{1}{4}$	46	$39\frac{7}{8}$	21	$21\frac{5}{8}$		

TABLE SHOWING THE PRINCIPAL DIMENSIONS OF THE COMMON LINKS OF THE SEVERAL SIZES OF CHAIN CABLES, TOGETHER WITH THE WEIGHTS AND TESTS TO BE APPLIED.

Size of Cable i.e. Diameter of Iron of Common Links.	Weight of 100 Fathoms of Cable with the necessary Joining Shackles &c., subject to the Latitude stated in clause 2 of the Specification.			Proof Strain to be borne without injury.
Inch.	Cwt.	q.	lbs.	Tons.
$3\frac{1}{2}$	588	0	0	176·4
$3\frac{1}{4}$	507	0	0	161·6
3	432	0	0	145·8
$2\frac{3}{4}$	363	0	0	129·3
$2\frac{9}{16}$	315	0	21	118·2
$2\frac{1}{2}$	300	0	0	$112\frac{1}{2}$
$2\frac{3}{8}$	270	3	0	$101\frac{1}{4}$
$2\frac{1}{4}$	243	0	0	$91\frac{1}{8}$
$2\frac{1}{8}$	216	3	—	$81\frac{1}{4}$
2	192	0	0	72
$1\frac{7}{8}$	168	3	—	$63\frac{1}{4}$
$1\frac{3}{4}$	147	0	0	$55\frac{1}{8}$
$1\frac{5}{8}$	126	3	—	$47\frac{1}{2}$
$1\frac{1}{2}$	108	0	0	$40\frac{1}{2}$
$1\frac{3}{8}$	90	3	—	34
$1\frac{1}{4}$	75	—	—	$28\frac{1}{8}$
$1\frac{1}{8}$	63	3	4	$22\frac{3}{4}$
1	52	3	6	18
$\frac{7}{8}$	40	1	20	$13\frac{3}{4}$
$\frac{3}{4}$	29	2	2	$10\frac{1}{8}$
$\frac{11}{16}$	24	3	23	$8\frac{1}{2}$
$\frac{5}{8}$	20	2	14	7
$\frac{9}{16}$	16	2	23	$5\frac{1}{2}$
$\frac{1}{2}$	13	—	22	$4\frac{1}{2}$
$\frac{7}{16}$	10	—	12	$3\frac{1}{2}$
$\frac{3}{8}$	7	1	20	$2\frac{17}{32}$

All Cables are required to stand 50 °/₀ more than the Proof Strain.

425. Number of Swivels in a Cable.— One in the first length, and one in the last length of each cable.

426. A Length of Chain Cable—Is 12½ fathoms. They are marked inboard from the shackle, on both sides, with a piece of wire or tin round the stay-pin of the link, a link for every shackle; the one next the shackle without a stay-pin not being reckoned. At the tenth shackle, when the cable is of that length, you commence again (though a cable, as supplied, is only of eight lengths).

427. Studs or Stay-pins.—Without them, the cable would become full of kinks; and, were they removed, the links would also collapse.

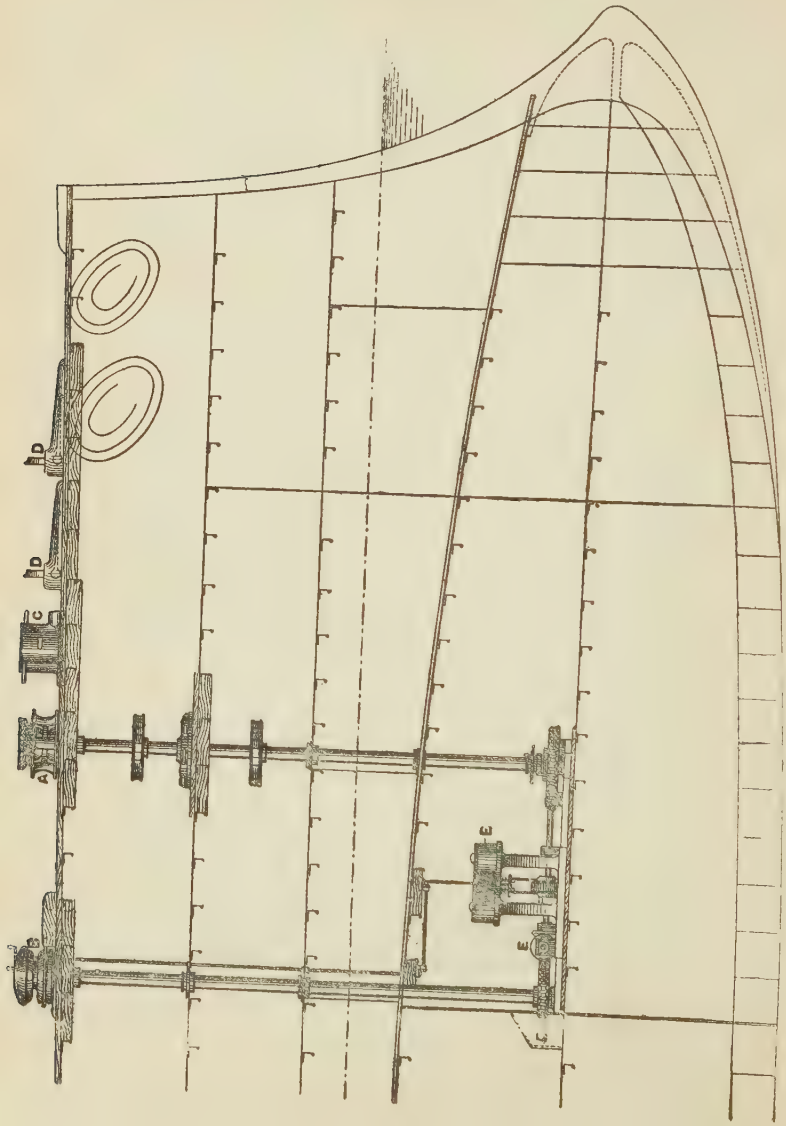
428. Of what Metal Studs are made.—Steel studs, preferably forged or stamped, have recently been introduced in place of cast iron studs used previously, in order to overcome the liability of the studs in the first and second lengths of the cable to break when dropping the anchor through concussion with the end of the links. Forged or stamped steel studs are superior to cast steel studs; there are however a large number of cables in the Navy fitted both with cast iron and steel studs.

429. A Ganger—Consists of one or more lengths of chain, shackled to the sheet anchor and brought into the hawse holes, or just outside, and renders the operation of bending or unbending sheet cable much easier.

430. That end of a Cable—Is shackled to the anchor which brings the bolt of the shackles and the cup of the swivels aft;—otherwise, they would catch the bitts, &c., in running out.

H.M.S. "ROYAL SOVEREIGN."

Arrangement of Harfield's Patent Anchor Gear.



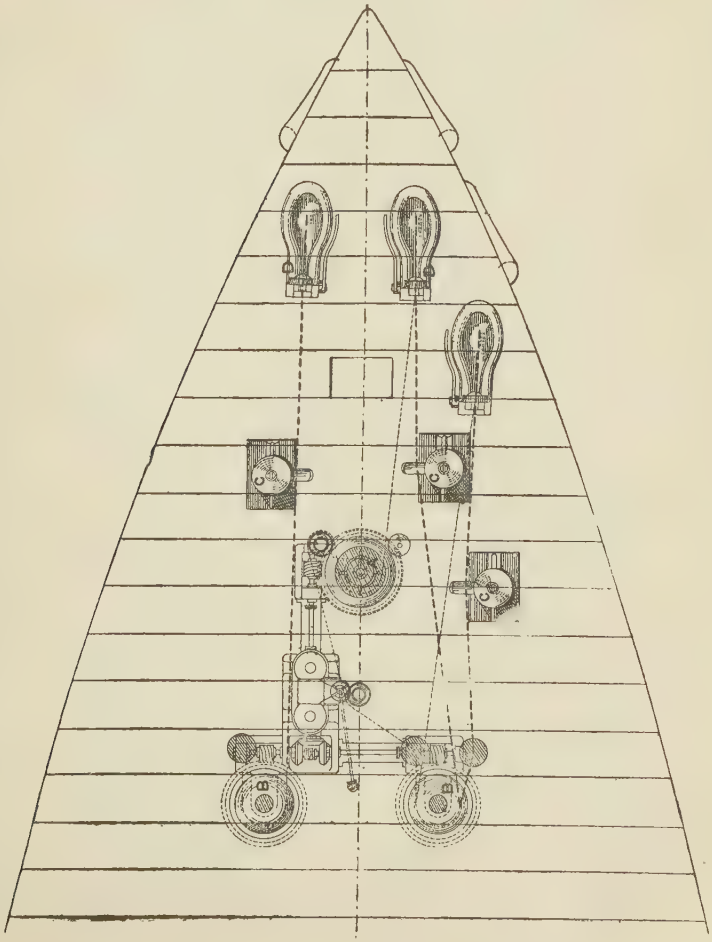
A. Main Steam and Hand Capstan to work $2\frac{9}{16}$" and $1\frac{1}{8}$" cat chain Fitted with patent portable whelps for working 8" wire ropes.

B.B. Patent frictionally connected cable holders for heaving, veering and riding $2\frac{9}{16}$" cables.

CCC. Riding Bitts for $2\frac{9}{16}$" cables.

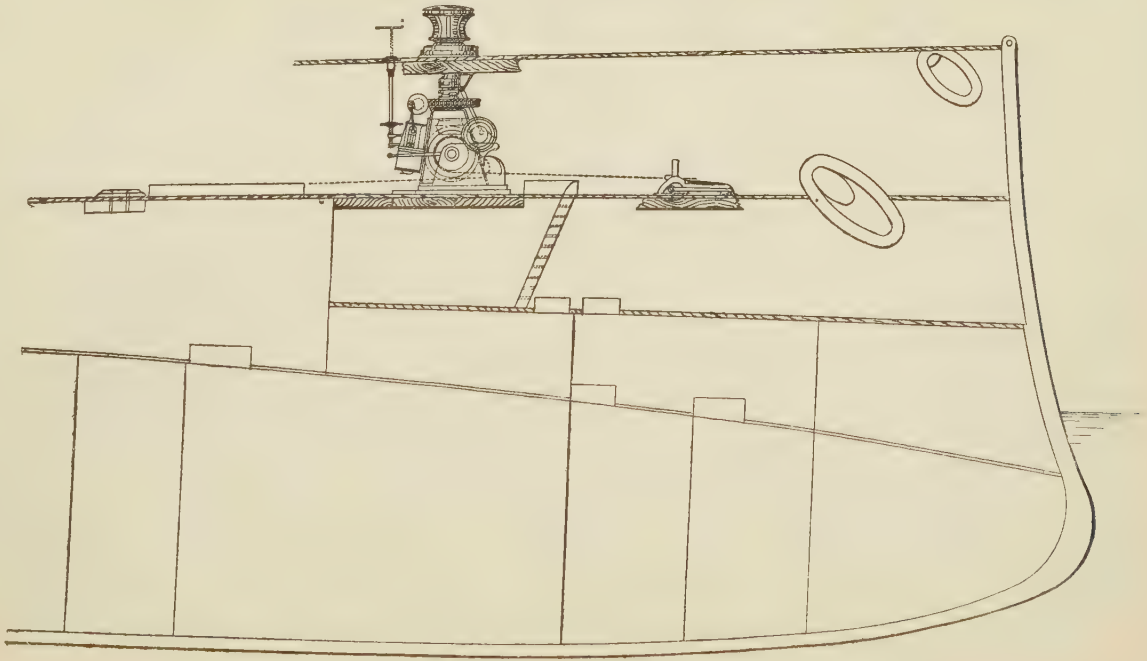
DDD. Patent Hawse-pipe Stoppers with fair-leads.

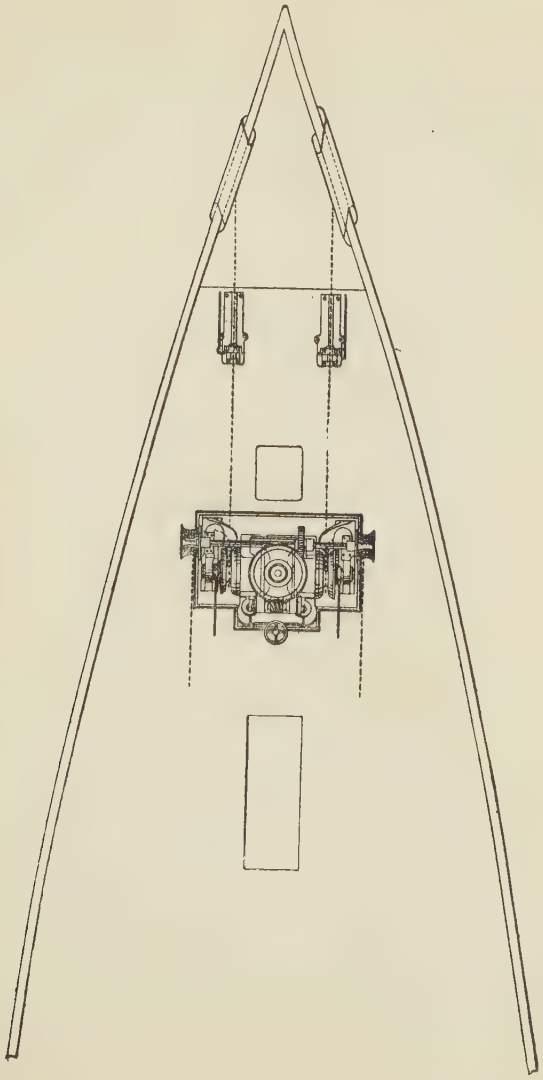
EE. Engine and patent gearing for heaving and veering the cables by steam, either together or separately, and in the same or opposite directions at the same time.



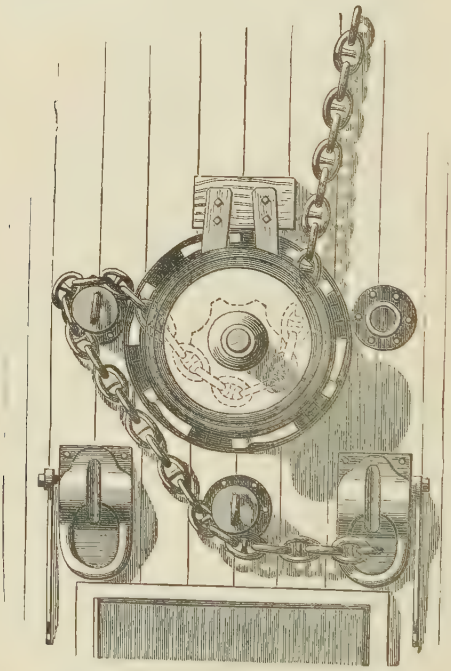
Harfield's Patent Improved Windlass, as fitted in H.M.'s 2nd Class Cruisers.

Arranged for working two cables, either together or separately in the same or in opposite directions, at the same time, by Steam or Hand.





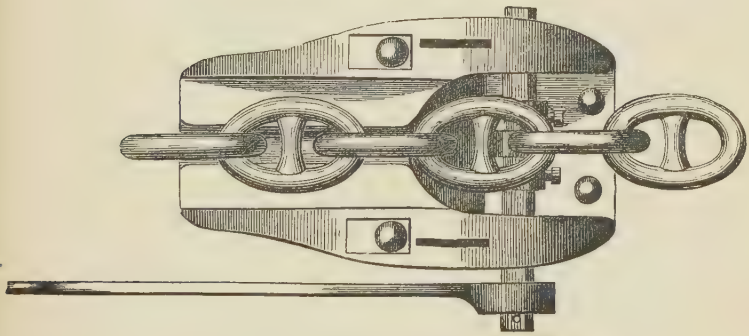
431. CAPSTANS.—In all recently built ships, except the smaller vessels, capstans are invariably worked by steam, provision is made to work by manual power in case the steam gear breaks down. Harfield (London) and Baxter's (Nottingham) are the principal firms that supply Naval capstans. The foregoing sketches show Harfield's capstans as fitted to H.M.S. "Royal Sovereign" and also to the 2nd class cruiser type.



Brown's patent capstans are in general use on board the older type of corvette, &c. These capstans are not worked

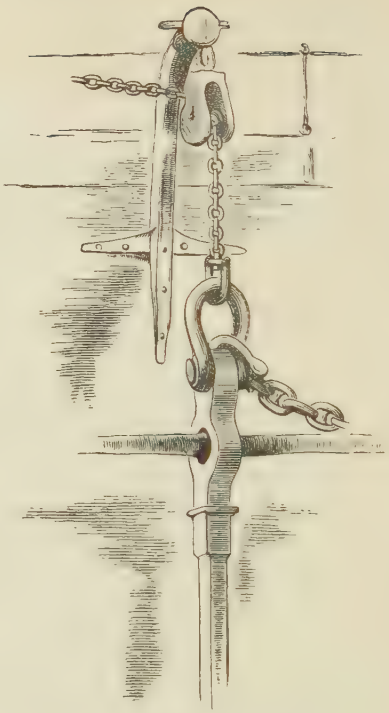
by steam, they are fitted with sprocket wheels, corresponding to the links of the cable, each link in turn binding in its corresponding indentation.

To *bring to*, put the slip on, unbit, and haul the bight of the cable, round abaft the capstan, drop in the roller, and lift the chain into the sprocket wheel; the slack chain is hauled clear of the capstan with iron chain hooks. All ships



also have a controller, into which the links of the cable successively sink as you heave in, and which of course relieves the capstan of much strain, the cable is thrown in or out of the controller by a lever at the side.

432. Bitting Cables.—Facing forward, the starboard cable is bitted with the sun, and the port against it; the cable from the hawse-holes leading under the cross-piece or battledore, on the outside of the bitts, and the bight thrown over the bitt-head. A bitting-tackle is used to rouse the bight up; the pendant rove through a swivel-gin over the bitts.



433. Cat—Chain & Purchase.———The Cat chain is a small chain used for catting the anchor, in place of a cat-fall. One length of small chain called the ground chain, shackles to the ring of the anchor and is stopped along the first shackle of cable; another length reeves through an iron block at the cat head, and before weighing, is led into the hawse-hole, in readiness for shackling to the part stopped along the cable when hove in; the cat purchase, which is a treble purchase led fore and aft the deck, shackles to the inboard end.

Very frequently a cat purchase is not used but the cat chain is taken direct from the cat davit to the capstan, in this case, a hauling off tackle is used to take off the slack chain from the capstan as it is hove in. In many cases, a wire catting pendant is used instead of chain and is brought

to the capstan, a hauling off purchase is not then needed.

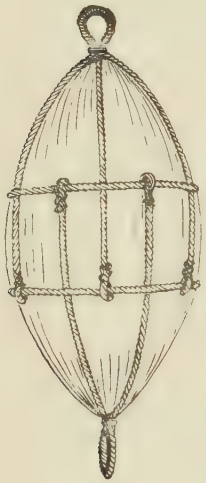
In all modern ships the ground chain is shackled to the centre or gravity band of the anchor instead of to the ring, the anchor is thus brought up square to the cat davit, and placed on the anchor bed without there being any necessity to use a fish chain.

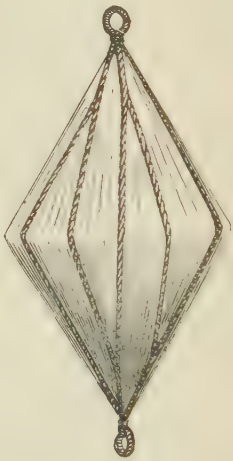
434. FISH CHAIN AND PURCHASE.—The fish chain is a small chain used for fishing the anchor when an "Admiralty pattern" anchor is used and no ground chain is secured to a centre or gravity band. It is fitted with a large hook at one end which hooks on the fluke of the anchor, the other end reeves through a block at the Fish davit and shackles on to the Fish purchase.

A Fish chain is not needed in ships with Martin's or similar anchors in which the ground chain shackles to the centre or gravity band.

435. A NUN BUOY.—Iron nun buoys are now supplied fitted with a ring and swivel at either end, to which the buoy rope is bent, with a sheet bend, and the end seized. There are two other ways of slinging an anchor buoy. The first commences by placing a strop or grommet round the buoy, on each side of the centre ; next, middling two pieces of rope, laying the bights on the top, and the ends down the buoy under the strop on their own end, and spliced round the strop on the opposite end ; then, with two other pieces of rope, the same thing is done on the other end, the strop roused taut

up by a jigger hooked to the bights of the slings, and a thimble seized into each end, which tautens the whole. The legs and strops are served, and the eyes hitched over.





In the second place, four pieces of rope are middled, and the bights of two laid over each end, forming the same number of legs as in the first; but no strops are used. Each leg of one end is spliced into the next right-hand leg of the other end; scores are cut in the buoy for their reception, and a seizing round the eye tautens them up.

436. Technical Phrases.—When a buoy leaks, it requires to be *bled* occasionally to let the water out, and is then plugged up again.

A buoy *watches*, while it maintains its position above water, and is not borne under by the strength of the tide or any other cause.

A cable *grows*, in the direction it leads from the hawse-hole, ahead—on the bow—or under foot, as the case may be.

When, from the fall of the tide, the water leaves a ship that is aground, the ship is said to have *sewed* so may feet or inches as the tide has fallen below her original water-line. The word *sewer* (drain), has the same derivation.

A cask is stowed *a-burton*, when it is stowed athwart-ship.

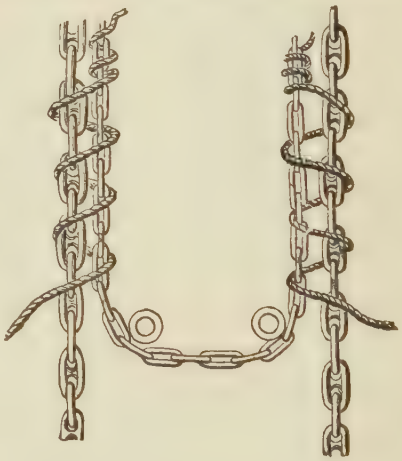
437. At the Order "Stand Clear of the Cable,"—Besides doing so, and standing by the compressor-tackle ready to bowse to, the chocks of the tumbler should be taken out, but the pins kept in till the order—"Let go the anchor," when they are taken out; but the lever is kept back, by hand, till the boatswain gives the word—"One, two, three—let go," at the last sound of which the anchor is freed by a rouse on the jigger.

438. On coming to with a Weather Tide.—Look out and give her a good sheer, to avoid being driven back over your anchor.

439 Weighing.—Put the slip on, unbitt, and bring to (this is with a patent capstan) heave round, off slip, keep paying down the slack chain; hauling the cable from the capstan with chain hooks, and aft with hook ropes; when up to the bows, avast heaving on slip, haul enough cable forward for bitting and catting, bit the cable, bowse to the compressor.

Hook the cat, haul taut, keep hauling, off slip, surge the cable, and away with the cat. When up to the cat-head, pass the ring stopper, hook the fish, ease up the cat, put on the stock pendant and bowse on it, haul away the fish. When high enough, turn with the fish, pass the shank painter, ease up, and unhook the fish, and bowse in the slack chain.

440. PASSING NIPPERS.—The *rationale* of passing a nipper rests upon the necessity for bringing the messenger to the cable, as you cannot bring the cable to the messenger, and at the same time rousing the messenger up to prevent its getting underneath the cable. Two or three turns are first taken round the messenger by a hand inside ; the coil is then passed over the cable to the, hands outside, who, facing aft, pass it round, messenger and cable, as the latter comes in ; on the port side with the sun, and on the starboard side against it, rousing each turn taut as it is passed. The end is then dogged round the cable, and twisted up with the end of the next nipper ; both ends are held on by a hand who walks aft with them, and, when far enough aft, the nipper is started and passed forward again.



Messengers are not now used, but it might be necessary to make use of one if all other anchor gear had carried away.

441. Hemp Messenger.—The ends are fitted with long lashing eyes, with the splice grafted over; but they are not brought close up to each other, as they would not lie fair round the capstan, the crown of the eyes, when brought together forming so great a rise: a drift of two or three feet is, therefore, allowed between them. Four turns are taken round the capstan, the heaving-in part being the lowermost. When the opposite cable is to be brought to, the ends must be unlashed and passed the contrary way, which may be done, without heaving the turns off, by slacking them round the capstan, and dipping the aftermost end through; the parts then placed fair, and the ends relashed. Hands must be stationed to haul back on the upper part as it comes round the capstan,

442. Heaving through all.—Strew well with sand, pass the turns thick, and, if that is not sufficient, take here and there a *round turn* round the messenger, and another round the cable, passing the racking turns between.

When obliged to use a deck-tackle to break out, heave on the capstan and haul on the tackle *together*, giving the time by a *slow* pipe. It is amazing the difference that this makes.

443. A deck Tackle—Consists of a runner and a long tackle, separately fitted, the double block of the tackle hooks to the runner, the single block and the other end of the runner are secured abaft. The block of the runner is secured to the cable; the tackle may be used without the runner.

Small vessels not fitted with capstans, usually have the double block of the tackle fitted with a claw to hook over a link of a chain.

444. The Cat is Hooked—from out—in, because it, is thus the more easily lowered and pointed through the ring of the anchor. The fish is hooked to the inner arm from forward—aft.

445 Before Surging—The cable should always be bitted; and also stoppered if the cat fall is old.

446. Secure an Anchor for Sea.—After catting and fishing, the ring of the anchor will be the drift of the cat hook below the cat-head, and must be boused close up; to do this hook the cat to a strop round the lower arm of the stock; and bouse close up to the cat-head, haul taut the ring stopper and unhook the cat; there are various ways of passing lashings when securing for sea round the stock and shank, which must depend much on the shape of the bow.

447. Anchoring with a Spring on your Cable.—Supposing the wind to be directly on shore, and you wish, on coming to, to bring your port broadside to bear upon it: you pass a hawser or stream-chain from the starboard quarter, in through the starboard hawse-hole: run a range of cable up before the bitts, and shackle or bend the stream or hawser to it, which, on the anchor being let go and veered on, you work with a deck tackle, and so you will be able to spring your ship to a nicety, providing there is no great shift of wind. Should this be an undesirable contingency, you must of course, anchor by the stern, with kedge, stream, or sheet anchors, according to the strength of the wind, and the im-

portance of the case. If there is no immediate hurry, bend the spring after the anchor is let go.

448. Keeping a clear Anchor in a Tideway.—In the by-gone days of hempen cables, owing to the injury done to them when lying on a hard bottom, and the facility with which, on account of their buoyancy, they fouled the anchor, tending it properly became a matter of serious importance; blunders were considered very discreditable; and the management of the ship at turn of tide required close attention and considerable experience. But now, thanks to the chain cables, a ship with a long scope of cable out, may lie for months in a roadstead without approaching her anchor, and in a tide-way, as mooring is not the tedious operation of former times, and a foul hawse can be cleared in one-tenth the time, ships seldom remain for any lengthened period at single anchor, However, when it is of importance to keep it clear, and an anchor watch is kept for the express purpose of preventing a foul anchor, there can be no reason why greater attention should not be paid to it than is generally the case; all that is requisite being a knowledge of the effect of the stream on the rudder, and of the head and after sails on the ship.

Supposing a ship to be riding by her S.B., with the ebb tide and wind from the northward, she requires, when the tide turns, to be sheered so that the bight of the cable may not fall over her anchor, which would be the case were she left to herself to drift up with the flood.

Before slack water, therefore, put the helm a-port, for, as a ship in a strong tide ought to lie with a slight sheer to keep her steady, you will not require to describe so great a

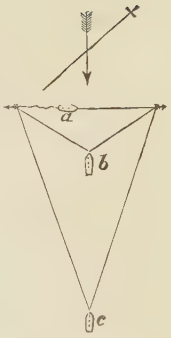
circuit, by canting with her head to the eastward, as you would if you went round the other way. Hoist the jib or staysail, according to the force of the wind, and haul the port sheets aft, or to windward. When the flood makes, shift the helm, and let draw and haul aft the head sheets as soon as they will take, which will set her ahead with a taut cable. As soon as it is brought at right angles to the wind, the tide, acting on her lee broadside, will drive her over, or to windward of her cable, when the head sails become of no further use, and are hauled down: the helm is kept a-starboard, to check her, and to keep her with her head sheered to the eastward directly the cable brings her up; in which position she will lie till the tide again turns.

When the tide turns, the wind remaining the same, set the jib and spanker and sail her round her anchor, head to the eastward, taking them in when they cease to be of service, and you will lie as before to the ebb tide, with the helm a spoke or two a-port.

Let the wind now shift to the westward; you must therefore, before the tide ceases, shift the helm a-starboard, and, as the tide slackens, she will come head to the wind; then hoist the jib with the starboard sheet aft, or to windward, and, as the flood makes, her stern will cant, and, dropping round to the northward—to leeward of her anchor, and head to the flood, the head sails will keep her steady and the cable taut. When the tide has fully made, haul the jib down.

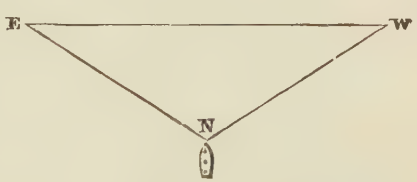
It is needless to place the ship in any other relative position to the wind; for, after what has already been said, the right mode of proceeding, in such cases as slightly deviate from the above, will at once be seen.

449. Mooring with open Hawse to any Bearing.—Drop the anchor N.E. and S.W. of each other—at right angles to the prevailing wind ; and, as the usual rule for veering cable is, to three times the depth of water, moor with about three shackles on each anchor, as at *a*, where she is shown lying with the wind from the N.E. When it shifts to the N.W. she will tauten both cables, and if not moored too taut, will drop down to *b*, in which position she will ride with safety in all ordinary weather. If the wind increases to a gale, you veer to *c*, with eight or nine shackles on each, previously dropping a third anchor if you think you will require it.



With the large Battleships and Cruisers now in the Service you would never moor with less than five or six shackles on each anchor.

450. Two Cables weaker than One.—In reference to this subject, Timmouth has the following valuable remarks on the nature and properties of a span :—



"Supposing a ship to be moored between two anchors laid out east and west, with the wind blowing at right angles to that line, I have calculated that supposing a ship could be maintained in a position in which the angle EWN is 5°, the whole amount of support which

the two cables would give to the ship is $\frac{17{\cdot}4}{100}$ parts, or about one-sixth the strength of one cable.

At the angle of 10° it would amount to $\frac{34{\cdot}7}{100}$

15° „ „ $\frac{51{\cdot}7}{100}$

20° „ „ $\frac{68{\cdot}4}{100}$

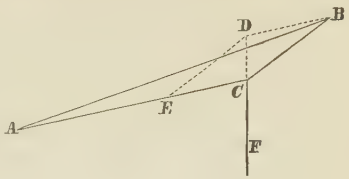
25° „ „ $\frac{84{\cdot}5}{100}$

30° „ „ the strength of one cable.

"Many experiments have been made with pieces of rope of various sizes, to determine this question, and in every case it has been clearly proved, that when a span is so placed as to have a less angle than thirty degrees, the strength of the two parts of rope or chain, of which it is composed, is less than the strength which one such part would have if placed in a direct line with the strain.

"In order to prevent the numerous, and, in some cases, fatal accidents which occur in the use of a span, it is necessary to investigate the peculiar character of a rope in this position, that by the evidence of established mechanical laws the reader may be enabled to understand why the small force of a few pounds, applied to a rope or chain when in use at a flat obtuse angle, shall produce the astonishing strain of eighteen hundred per cent. upon it.

"Let a rope be extended from A to B with any degree of tension; if a force, however small, be applied at any part of the rope, in any direction out of the line AB it will cause a deflection, increase the tension on the rope.



"Let the force F be applied at C in the direction D C F, and let the rope take the position A C B. Let any length, C D, represent the force F; draw D B parallel to A C, and D E parallel to C B; then C B will represent the tension produced by F on the part C B of the rope, and C E that produced on the other part of the rope A C.

$$EC = F \times \frac{\text{sine DCB}}{\text{sine ACB}}; \text{ and } CB = F \times \frac{\text{sine DCA}}{\text{sine ACB}}$$

"Supposing F be taken = 10 lbs.; the angle A C B 175°; and D C B = 50°; then the angle D C A will = 125°, and E C, or the tension on the part A C of the rope = 10 lbs $\times \frac{\text{sine } 50^\circ}{\text{sine } 175^\circ} = 87{\cdot}8$ lbs. C B, or the tension on the part B C of the rope = 10 lbs. $\times \frac{\text{sine } 125^\circ}{\text{sine } 175^\circ} = 93{\cdot}9$ lbs.

"Hence, the greater the obtuse angle A C B, the greater the tension on the part of A C, or C B, or on both parts, according to the direction of the force applied.

"If the force F, and the angle A C B, be supposed to be constant, the effect of varying the direction of the force may be seen.

"Thus, if D C F, the direction of the force, bisects the angle A C B, the tension of A C is equal to that of C B; and the tension on the whole rope A C B is a maximum.

"Again, if D C F be perpendicular to the part A C of the rope, the maximum tension is produced on the other part C B; and if D C F be perpendicular to C B, the maximum tension is produced on the part A C of the rope.

"It will be seen by this example that the small force of 10 lbs. applied to this span produces an effect of 87·8 lbs. upon one part of the rope, and 93·9 lbs. upon the other part; the whole effect being 181·7 lbs., that is, upwards of eighteen times the force applied. A still greater effect might be produced by more obtuse angle."

451. KEEPING A CLEAR HAWSE IN A TIDEWAY.—We will suppose the river to run north and south, on which bearing the anchors are laid out; and that you are riding by the B. B. with the ebb and wind from the northward. On the tide turning, you will, therefore, bring a cross in your hawse if you swing with her stern to the westward. To avoid this, set the spanker and haul the boom over on the port quarter; put the helm a-port when the flood begins to make, and take the spanker in when the wind is brought on the starboard quarter.

Before the ebb makes again, you must be prepared to cant her back to the eastward, now riding by the S. B., with the wind still from the northward; therefore, set the spanker, ease the boom over on the port quarter, and attend to the helm.

In the first case, riding to the ebb by the B. B., should the wind shift to the eastward, you cannot avoid canting to

the westward, and, on being tide rode, you will ride with a cross in your hawse; but this will be taken out on the flood making, should the wind remain the same.

The head sails will assist in canting, or at any rate, will prevent her swinging back again when the spanker is of no further use—the contrary sheets to that of the boom being hauled aft. But it must be borne in mind that the great canting power is the spanker, the boom being hauled right over on the weather quarter; and, if this will not cant her, you must be moored too taut.

452. PUTTING A SWIVEL ON.—Veer, or heave in on the riding-cable, if necessary, in order to bring the shackle, where you intend to put the swivel on, before the bitts. On slip before-all, unshackle and shackle the ends to an upper and lower link. Stopper the other cable inboard by putting the slip on, or hang it by the clear hawse slip attached to a wire hawser, unshackle, haul each end in alongside the riding-cable by a small hawser passed round the cut-water,—the bight being kept up by a bull-rope from the bowsprit, and shackle the ends to the remaining links of the swivel. Off stoppers of both cables (that of the riding-cable last), veer the swivel out clear of the hawse-hole, haul in the *slack* of the other cable, and make all fast. Ride in this way, by one cable inboard, for, when the swivel is hove up amid-

ships, the copper corrodes the cable, and the cable chafes the copper. In fine weather, as soon as the swivel is put on the riding-cable, it may, if you prefer it be eased out, and the other cable shackled in a boat under the bows.

Though it is customary to shackle both inboard ends to the swivel, the propriety of doing so is not quite clear, for should it come on to blow, and you find is necessary to veer, you pay overboard the second cable without deriving any advantage from it whatever.

453 THE CUP OF THE SWIVEL.—Should be kept up, and tallow put into it occasionally.

454. TAKING IT OFF.—Bring to the riding-cable (say B.B.), stick out S.B—hauled out clear of the cutwater by a bull-rope from the bowsprit, and heave swivel and all parts in through the starboard hawse-hole. It is immaterial which cable you clear first; but, supposing it to be S.B., put the starboard slip on the outer part of the port cable, unshackle, from the swivel, shackle both ends together, off slip, and let run. Then put the slip on B.B. before the swivel, unshackle and shackle the ends again, bowse to the compressor, and off stopper.

If you think it undesirable to heave in, you can unshackle it in a boat out-board. Riding, therefore, as before by B.B,, and with the swivel hove up on the starboard side, pass the small slip attached to a wire hawser, out of the spare hawse-hole, and put it on the port cable below the swivel; heave taut on it, unshackle, shackle the ends, and off slip. Proceed in the same manner with the riding-cable, hanging the swivel with a hawser to rouse it in by.

455. MOORING WITH THE SWIVEL ON.—You render it impossible, by any amount of heaving, to do as you intend, for you have made no allowance for the depth of water. If the cables were laid taut along the ground in a direct line, the fourth shackle of each, under the circumstances stated, could of course be joined—on the bottom; but, when attached to the bows of a ship, the difference between the base and the other two sides of the triangle is the measure of the increase of cable required to unite them. In this case, therefore, you would have to veer another shackle on one cable, mooring with five on one and four on the other; or, else, weigh the second again, and drop it closer to the first.

By running out seven shackles in the first instance, before dropping the second anchor, then veering four, and heaving in three, you would have been moderately taut moored. The time of tide is also to be considered; (at Portsmouth, the rise and fall of spring tides being twelve feet).

456. UNMOORING, WITH A SWIVEL ON.—If the cables are up and down, there may be a cross in them below water; and therefore, if you have nothing to guide you, you will likely enough shackle the ends of different cables together; but, by remembering which legs of the swivel the cables were shackled to when you put the former on, you cannot misplace them. For instance, if the long legs were both on one side, and the B.B. shackled to them, you at once know which is the starboard cable. If either of the cables is taut, of course there is no difficulty.

457. CLEARING HAWSE.—Bring the "clear hawse" with hawser rove to it, out through the spare hawse-hole, and put it

on the dipping-cable (being the one she is not riding by), below the turns. If they are not above the water, you must heave in on the riding-cable, and bring them up; and, if they still run below water, you must lash the cables together as far down as possible, clear what are above the lashing, heave up to it, and put the clear hawse slip on if you can, but if not, lash again, and, lest the lashing should slip after you have unshackled the end, put a bolt through the links of both cables and pass the lashing round it. Bowse taut the clear hawse slip and belay it; put the slip-stopper on, and unshackle the cable at the nearest shackle abaft the slip, which, on mooring, should always be veered before the bitts, in anticipation of clearing hawse. Pass the bowline (which is a small hawser rove through a block on the bowsprit, and leading in on the forecastle) through the hawse-hole, and bend it to the end of the cable; then bend a stouter hawser to the same end, knock off the slip, and haul out on the bowline. When outside the hawse-hole, unbend the hawser and dip it round the riding-cable the contrary way to the turns, the bight of the cable hanging by the bowline. Haul the cable taut in from the clear hawse slip, by the hawser, unbend the bowline, and the turn comes out. If there are any more, bend the bowline, and repeat the operation. When finished, put on the slip, unbend the hawsers, and shackle the cable, take off the clear hawse slip and finally the slip-stopper.

458. Mooring Head and Stern.—The appliances for securing stern cables are usually very insufficient. Some ships are unprovided with either bollards or ring-bolts. When this is the case, having passed the cable out through

the bow hawse-hole, and brought it round outside, reeve it in through one stern-hawse-pipe, out through the other, and shackle it to its one part, outside with a slip-stopper.

Let go headmost anchor, veer away, let go stern anchor from the bows, heave in forward, and veer away stern cable to the slip.

459. VEERING CABLE IN A GALE.—If B.B., brace the yards for casting to port, hoist fore topmast staysail with the sheet to windward, put the helm a-port, and veer away by short drifts at a time, having the lanyards of the deck-stoppers merely eased up, and kept manned ready for rousing taut. By thus canting her broadside up to the wind, she will drift slowly, and take the cable easily.

460. WHY YOU VEER CABLE IN HEAVY WEATHER.—The chapter *On the Properties of Chain Cables*, in Mr. Tinmouth's work, to which the reader is referred, is the best answer to this question.

* "The hemp cable," it is here remarked, "is well known to possess the valuable quality of elasticity sufficient to accommodate itself to any variety of strain when used as a cable, but the chain is, on the contrary, so stubborn and unyielding, that nothing but a long scope can render it safe; this is equivalent to additional strength, it permits the ship to rise over each successive wave, under the constant pressure of a great strain, preventing entirely the danger of sudden jerks, which, of all other trials, is the greatest and the worst to a chain.

* Abridged.

"It is a prevalent but fallacious notion, that, even when used in deep water and with a severe strain, the curvature or deflection of chain is considerable, and that near the anchor it rests upon the ground undisturbed by either the pitching motion of the ship, or the tension which she causes. At a testing strain of 630 lbs. per circular $\frac{1}{8}$th inch, the utmost deflection was found to be only 10 feet upon a length of 100 fathoms, in 10 fathoms water, with the hawse-hole a fathom above the surface; the diameter of the chain being $1\frac{1}{2}$ inches, and the strain $40\frac{1}{2}$ tons.

"In a common gale, which would produce this strain, not one link of the 100 fathoms of chain will quietly rest upon the ground; on the contrary, it will be found by the experiments on a depth of 10 fathoms, that 127·98 fathoms of chain are required to form a semi-catenary* when suspended in air, and 137·03 fathoms when in water, the buoyancy of which must at all times have its influence. If the strain be less than that mentioned, the curvature will be greater, and no danger need be apprehended; but in a severe gale, the force of which may be supposed equal to, or nearly equal to, a breaking strain, it must be evident that a long scope is the only way to prevent a fatal result; and any man in charge of a ship at anchor, with the necessary quantity of chain cable on board and space astern to allow him to make use of it, but who neglects to do so, must be considered the author of his own misfortune, whether it may amount to the loss of his anchor or the loss of his ship."

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* A *catenary* is the curve into which a flexible chain of uniform density and thickness forms itself when suspended, or allowed to hang freely from two points.

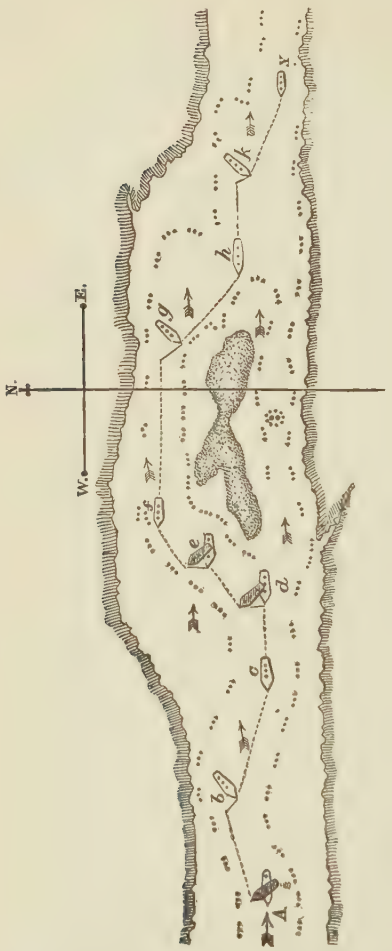
461. Letting go sheet Anchor.—The cable being shackled and clear inboard, cut all stops of the ganger but one or two outboard; clear away the berthing, see the anchor clear, jigger hooked to the slip, &c., and guns run in that are likely to be caught by the cable. From forgetfulness of this, a ship some years ago, letting go the anchor in a hurry, had a gun dismounted, the carriage disabled, and a beam sprung, by the cable falling across the muzzle.

462. Riding out a Gale.—All other things being equal, the greater the weight of a ship the greater the strain on her cables.

The weights should not be too much centralized, for inertia in the extremities serves to keep her from flying round like a teetotum. Neither should they be placed too low, especially if the masts are cut away.

If necessary to cut away the masts, a dangerous alternative in a screw steamer, the mizen-mast had better be left standing.

463. Backing and Filling, and Dredging.—When with a foul wind, but with the tide in your favour, you are in a river that is too narrow to admit of the ship beating down, "backing and filling" must be resorted to. If only at one or two points the river contracts so as to render this necessary, you may handle her by hauling the mainsail up, taking the spanker in, and bracing the head yards a-box, as you approach the narrows; squaring them if she falls round off,—bracing the after-yards aback, if requisite, filling if you wish to forge across the river, or bracing aback, when



necessary to near the other bank.

In some rivers, however, as that, for instance, on which Shanghai is situated, you are compelled to keep in mid-channel from the anchorage to the embouchure and therefore should weigh under as small sail, only, as is sufficient to keep her under control. Under ordinary circumstances, the jib and main topsail are the handiest sail to work under, though you would increase it if the wind fell light. Under this back and fill, ease off and haul aft, as requisite.

In the event of the wind failing entirely, the ship, necessarily would drift at the mercy of the current, unless some

other aid than that of sail were called into play, to enable you to keep her in the fairway and to avoid the shoals and dangers in the route ; and through the instrumentality of the anchor it is, that this is effected by what is termed "dredging." In narrow waters no manœuvre requires so nice an exercise of judgment, and under no circumstances are a quick eye and a clear head more requisite. While dropping down, the anchor is kept hanging by the slip, just clear of the bottom, and it is let go, and a fathom or two veered according to the strength of the tide, when it becomes necessary to sheer over to one bank or the other. The capstan is kept manned ; and as soon as the anchor is dropped, the cable is brought to again, ready for tripping the moment she is sheered over into the position required.

To illustrate this, let us suppose that a ship at A wishes to drop down to Y ; that the three-fathom mark, represented by the dotted line, is less than her draught of water ; that there is a dangerous bank midway ; and that the arrows denote the direction of the tide.

On heaving up and down at A, the helm is put a-port and she is sheered over in position of the shaded figure ; the anchor is tripped, and with her head the same way—the helm being kept over while heaving up—she is dropped down to *b*. Here it becomes necessary to sheer her over to the south bank ; the anchor therefore is let go, the helm put a-starboard, and she is sheered over to *c*, thence allowed to drop down to *d*. From this position, by successive stages, she is sheered by the helm right across the stream, and, on arriving at *f*, proceeds as at first, till she reaches her destination.

464. Anchor comes up with the Stock gone.—Cat it, and ship the spare anchor stock.

465. Foul Anchor.—If with the flukes uppermost, pass the end of a hawser up the forescuttle; get an anchor-strop on the arm which is most convenient, hook the cat to it, run it up to the cat-head; hang the anchor by the hawser passed over the thumb-cleat and with the end hitched round the cat-head; haul taut, unhook the cat and shift it down to the ring; ease down the hawser, away with the cat, and clear the cable, using the ring-ropes when wanted, and, when clear, haul in the slack of the cable. Slue-ropes on the stock are often of great assistance in clearing the chain.

When an anchor comes up foul, with a turn round the stock, and you cannot clear it at the bows, or hook the cat to the ring, you hook it to an anchor-strop passed round the anchor so as not to jamb the chain; and, when up, clear it by dipping or unshackling it.

466. Cat block gone.—Replace it with the spare one.

467. Letting go from the Bows.—Before letting go, you must put the slip on, bit the cable, and haul the compressor back.

468. Sweeping for an Anchor.—Divide one or two deep-sea lead-lines, according to the depth of water, be-

tween two cutters. Pull to windward of where you suppose the lost anchor to be (knowing your former bearings); drop the bight, weighted with leads at intervals, and open out. Pull gently down to leeward, keeping the leads at the bottom until they catch the anchor; then cross the boats and haul up to it.

If there is much cable attached, see if you can get hold of it with a creeper near the end; and, if you succeed, take it in through the hawse-hole, shackle on, and weigh the anchor. In case you should be too far off to weigh it from the berth in which you then are, get under weigh again and warp up.

If unable to get hold of the chain, send launch and pinnace away with a hawser, and guided by the cutter which has got hold with the lead line, drop the bight of the hawser over the anchor; knot a piece of rope round both parts of the former, as close as you can without having it so taut as to prevent its running down; sling a couple of shot to it, and, in order to jamb both parts and prevent the anchor slipping out of the bight when heaving up, let it slip down the hawser. A large anchor-shackle may be used instead. Pass the ends of the hawser in, clap a deck-tackle on one part, take the other round the capstan, and heave the anchor up.

469. CAT-HEAD CARRIED AWAY.—Brace forward the fore yard, and secure it as for hoisting the launch in. Lash a top-block on the yard to plumb the bows, and through it reeve the top-tackle pendant, passed over the cap and hitched round the quarter of the fore yard. Reeve

the top-tackle purchase on deck (splicing two together if necessary), take the cat for the lower block, to which secure the standing part, and reeve the hauling part either through a leading-block or the upper block, and thence on deck through a block on the cap. Trice the purchase up by the yard-tackle—lashed in, and hook it to the pendant. Overhaul down, hook the anchor and hoist it up ; fish and secure it in the usual manner, except that the ring is brought in to the side by the cat-head stopper taken round the timber-head.

470. Getting a sheet anchor into its place.—Cat the anchor, hang it by a hawser rove through the ring and unhook the cat. Pass an anchor strop over the flukes, slip it up the shank, and lash it up to the other stock. Put another strop round the crown. Trice the purchases up, and secure the yard as for getting the launch in, but bracing the main yard forward, and getting a sail-tackle up from the bowsprit cap for a preventer fore brace. Hook the fore-yard tackle to the strop on the stock, the fore purchase to the ring, and the main purchase to the strop on the crown.

Ease away the hawser, keeping the bight of the chain up by a burton from the fore yard ; haul away the purchases ; have a stock-tackle led along the deck ready to clap on if required, a tackle from the main chains to rouse aft if wanted, and a stay-tackle to lift the flukes in if the drift from the main yard is very great.

471. Transporting Waist Anchor to the Bows.—The quickest way is to let it go, then weigh and cat it.

472. Coming to with an Anchor that has only one Arm.—Cock-bill the anchor before going in; hang it from the cat-head by a hawser through the ring, and reeve the buoy-rope through a block on the bowsprit. Reduce speed and, on the ship getting stern way, ease the anchor down square by the hawser and buoy rope, with the fluke forward; veer cable on reaching the bottom, and, when you find that it holds, unreeve the hawser and stream the buoy.

473. Weighing under sail in a Fresh Breeze, with a Vessel close astern.—Heave in as short as safety permits; loose the courses, jib, and spanker, brace the yards for casting, set the foresail, and hoist the jib with the sheet to windward. Trip your anchor, attend the helm (the watch below and idlers remain at the capstan, watch on deck make sail), board the main tack, and brace round the head yards when she pays off, haul out the spanker, let draw the jib-sheet, cat the anchor, and loose the topsails.

474. A Swell on the Port Bow, and not room to cast to Starboard.—Lay a kedge out, buoyed, on the starboard beam; pass the hawser out of the starboard quarter port, reeve it through a strop and toggle on the ring of the anchor, and bend it to the crown. Bend a lanyard to the toggle, and let the boat that lays the kedge out hold on to the buoy, and stand by to slip the toggle. Shorten in, spring on the hawser, weigh under the jibs, slip the toggle, trip the kedge and run it up to the quarter, hoist your boat up, loose and make sail.

475. Weighing in a Weather Tide, with the Ship taut ahead of her Anchor.—The ship will not lie broadside to the tide, because the effect of the tide on her broadside may be greater in proportion than that of the wind; and she may still under the same circumstances remain ahead of her anchor, because the wind acts with greater force on the ship's stern and on the squared yards, than the tide does upon the bow. Riding them by the S.B. at *a*, port the helm and sheer her over to *b*, where she will remain at a taut scope, stemming the tide; then heave in.

476. Weighing under Sail from a Close Berth.—Make sail, weigh, and cast to port with the head-yards a-box, and the after-yard square, towards the object you wish to clear, with the helm a-port; for as you necessarily get stern

way in casting, you recede from the danger by turning her head towards it, as is shown by the ship *a*. Starboard the helm as she gathers way, brace up the after yards, and come to the wind on the port tack.

Were you to cast to starboard, or from the danger, you would back into it, stern foremost, as the ship *b* has done.

477. The Anchor should not be tripped.—Until you see that the ship is canting the right way ; and, if coming to the wrong way, you must hold on till she casts as you require.

478. Weighing under Sail in Half a Gale of Wind, close to a Lee Shore.—Pass a stream-cable from the quarter port, forward, on the side of the tack which you intend to stand on, and shackle it to the bower cable, in or outboard as most convenient. Send hands aloft to be in readiness to make sail, taking in such reefs as are necessary ; man the topsail sheets and halyards, having braced the yards about a point forward ; veer gently on the cable during a lull, heaving round on the stream till the wind is nearly abeam ; sheet home the topsails and hoist them ; and as the sails will be shaking, little strain will be brought on anything, nor much additional pressure on the ship. Be ready to slip the cables, man the lee braces, mizen sheet, and fore topmast staysail halyards ; brace up, hoist away and haul aft ; man the fore and main tacks, slip the cables, and haul aboard.

479. Backing an Anchor.—If in preparation for hurricane weather heave in or veer away on the anchor down, say B.B., till you bring the fourth shackle some few fathoms abaft the bitts ; put the slip on, unshackle and unbit ; pass the end out and shackle it to the ring of S.B., which has been eased down to the hawse-hole ; off slip, and ride by S.B., cable, with its anchor at the bows until the gale comes on, and then veer it down to the ground. Should the gale pass off, you can hang the B.B. cable outside by the clear-hawse pendant, and replace both in their original position.

If, on veering to 50 fathoms on S.B., you found the gale still increasing, shackle the remaining hundred fathoms of the B.B. to it (supposing that there are three cables divided between the two bowers, as is usually done),—let go starboard sheet anchor, and veer away on both. Finally, if compelled by the violence of the storm to make the utmost of your resources, shackle the other sheet cable to the end of the one already down, and veer away on both to within a few fathoms of the clinch, keeping that in to freshen the nip of the cable with. You will then, it is to be hoped, ride it out with three anchors down, and 500 fathoms of cable ahead.

With more than two cables ahead there is little probability of the strain being equally divided, unless they are systematically laid out in fine weather; and, with four anchors down, ships have snapped their cables one after another, partly from the same cause, and partly from the fatal effects of sudden jerks upon a short scope—such as a hundred fathoms would be in a gale of great severity. But an anchor is backed only when the holding-ground is bad.

A length of 250 fathoms on one anchor is perhaps unnecessarily long, though in the above case it was demanded by the position of the sheet anchor, which you were obliged

to veer on, because (as generally happens in practice), it was not dropped until, having veered on the riding-cables, you were compelled, on account of the increasing wind to let it go. But, to ride a storm out, you should certainly not have less than 150 fathoms of chain on each anchor, in 10 or 11 fathoms of water; and, if no chain is expended in backing, you can afford this on each of the bower anchors when dropped near each other: veer then, three shackles on each, and hold on at this as long as you can. When the gale has set in, let go the sheet and veer away on all three anchors; shackle the two sheet cables together, you will then lie with three anchors ahead, with a cable and a half on each, which is probably the best disposition that can be made.

480. To MAKE A SMALL KEDGE MORE EFFECTIVE.—Lash a pig of ballast, or other convenient weight to it.

481. LAYING A BOWER ANCHOR OUT BY A LAUNCH USING TRUNKS.*—There are many different plans of carrying out an anchor, and each has some special advantage to recommend it, but should your launch be fitted with trunks, and the water where the anchor has to be placed, not very shallow, I believe there is no plan better than the following.—Reeve the cat and fish falls, and put the stock tackle on, haul taut these, slip the shank painter, cockbill the anchor, off ring stopper, and stock tackle. Ship the midship trunks, windlass, and anchor davit in the launch, and haul her before or abaft the anchor as the case may be, taking care that her head is to the sea, and her stern near the anchor.

*NOTE.—It is very doubtful whether the method here described of slinging the anchor under the boat would answer with the heavy anchors now supplied to modern ships.

When you have placed the boat, put the bight of stopper over the nearest fluke, half knot it—or better still—cross and seize the parts close to the fluke, bring the ends up through the trunks, and with the windlass heave the anchor close up to the boat, lowering the cat at the same time. Then take another stopper through the ring of the anchor,—one end is taken over the roller in the stern davit, and led through the ring-bolt of the after slings with a round turn, and secured to a thwart; the other may be led over the stern, and set up with a luff hooked to the ringbolt of the foremost slings: rouse the ring of the anchor close up to the launch's keel, after having unhooked the cat.

Send as much cable with the anchor as the boat can safely carry, and make fast another boat astern of her with the remainder.

Meanwhile, the cable has been stoppered at frequent intervals; and a cutter has been despatched with a kedge and hawser for them to warp out by. This kedge should be placed well ahead of the position in which the anchor is to be dropped, otherwise it will come home before the launch gets there: the cutter should then return on board with the hawser. Pass the warp into each, let all hands clap on, haul away, and pay out the cable to the bottom as you go. If each fake is stoppered to a thwart or ring-bolt, in the boat as it is coiled away, there will be no danger of its taking charge when you pay out.

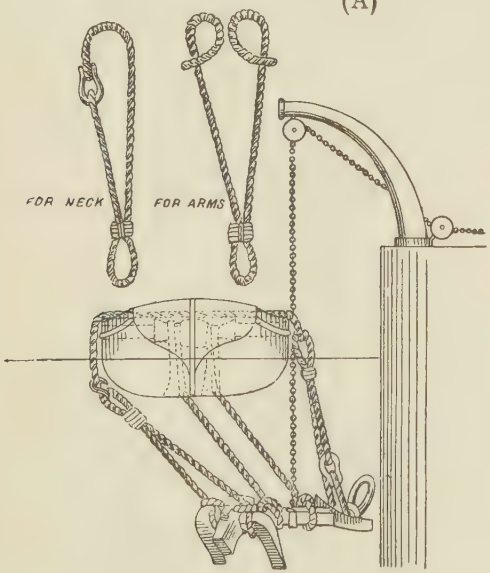
As soon as you have warped up to your position and all the cable is payed out, ease down the luff until the anchor is clear of the boat, have a sharp axe ready in case of anything holding, stream the buoy, and slip the stoppers together at the order "let go."

If you hold on the cable till the anchor is let go, and then pay out as you return on board, you must first ease down sufficient to reach the bottom, or the anchor on being let go will take the boat with it. For this purpose, a bight of chain is usually stopped round outside the boat, ready for dropping; and, if this is not enough, more must be payed out.

If you have to warp out against the wind and sea, lay the cable down on your return; if before it, pay out as you go.

Anchor slings for the Boat

(A)

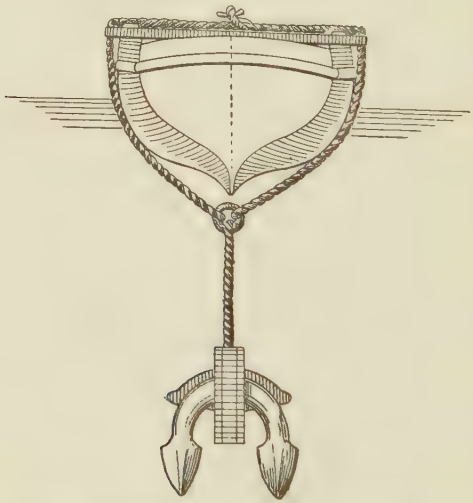


The Plate (A) shows the method adopted when the fittings are used as supplied by Establishment. Two 7-inch

trunk pendants, about 40 fathoms long, and two wire strops are supplied when the ships are fitted out.

The anchor is lowered from the Cathead by the Catting chain and taken under the boat by the two trunk pendants fitted with running eyes, rove round the shank of the anchor each side of the catting chain, and brought up through the trunks, the anchor is hove up close to the bottom of the boat by the windlass, the slings are then brought across the boat and toggled together for letting go. When the anchor is secured the trunk pendants are rounded off from the windlass and passed out clear of the trunks.

(B)



The method of slinging the anchor most frequently adopted is shown in Plate (B); it is simpler and more expeditious than any of the others, but has this disadvantage, that the anchor cannot be laid out in shallow water.

A strop for slinging the anchor is used fitted as follows; to a ring or shackle are attached three wire pendants or strops, two of the pendants are brought round the boat and over the anchor thwart (a large thwart specially fitted to rest on the gunwhale) and are secured by a slip or toggle, the third pendant is shackled to the anchor at the balancing or gravity band. The anchor is lifted off the bill board by a wire pendant shackled to the balancing band (instead of using a cat chain), the third leg of the boat sling is also shackled to the gravity band and as the anchor is lowered in the water the other two legs of the slings are brought round the boat and secured by slip or toggle.

The ground chain is left shackled on to the length of cable.

(C)

In a masted ship, to lay out a Bower Anchor without using Trunks.—Four strops are used for slinging the anchor fitted as shown in Plate (C). The strops are supplied by Establishment when the ship is fitted out. The anchor is lowered down square from the cat head by means of the cat chain shackled to one of the strops round the shank, which is lashed to the stock to keep the stock square and purchase from the foreyard, which is braced forward, secured to one of the strops round the arms. When the anchor is lowered sufficiently, the launch hauls over it, the two other strops are then brought up one on each side, passed over the anchorthwart and secured together with a slip or toggle. Ease up and unhook the cat and fore yard purchase.

Should you find, on easing down, that the boat will not carry the anchor safely, take the weight off it again, and lash as many water-casks under the bilge as you think will be sufficient (the buoyancy of a butt being eight cwt., and that of a puncheon upwards of five).

It must be borne in mind that the weight of anchor in the water is less than what it is out of the water, by the weight of water that it displaces. The specific gravity of wrought iron is 7·788, and of salt water 1·026; therefore, the specific gravity of iron in relation to water—7·788 ÷ 1·026, is 7·59. Consequently, the weight of the anchor, divided by 7·59, gives the decrease of weight when the anchor is submerged; in the case of a 120 cwt. anchor this decrease in weight is equal to 15·81 cwt.

Or, the decrease of weight consequent on the immersion of a body may be found by calculating its cubic contents, and

then ascertaining the weight of its equivalent bulk of water.

90 cwt. = 161280 oz., which, divided by 7788 (the specific gravity of iron reduced to the same standard), gives a quotient of 20·7, being the cubic contents of the anchor in feet. Now a cubic foot of salt water weighs 64·2 lbs.; and therefore, 20·7 cubic feet weigh 1329 lbs., or 11·86 cwt. as before.

482. Laying Sheet Anchor out between two Boats in heavy Weather backed with the Stream.—Hoist out the two pinnaces : send one away to run out a kedge, and in the meantime, get the stream anchor and part of the stream chain cable into the other. To the stream cable lash a block, large enough to take a 7-inch hawser, at a distance from the anchor equal to about twice the depth of water in which the anchor will be let go. Reeve and middle the hawser, and pass both ends inboard. Warp the boat out by the kedge, and let go the stream anchor well in advance of where the sheet is to be dropped. Leave a cutter to buoy up the cable when the block is lashed, and come on board.

While this is being done, the yard-tackles are got down, the anchor slung and lowered down square, stock athwartships. Two spars are placed across the gunwhales athwartships and lashed securely to the boats. The boats being hauled up on either side of the anchor, it is slung with a long strop round the upper fluke, passed over the foremost spar, and toggled to a strop, round the shank abaft, which is passed over the after spar; and the stock, lying across the sterns, is lashed to each boat to keep it steady. The 7-inch hawser is then made fast to the boats, and they are hauled out on board the ship, to where the cutter is buoying up the

stream cable. This they take in, and sends the cutter back with the end of the 7-inch. When they get hold of the hawser on board, it is bent to the end of the sheet cable (the ganger being unshackled); then the hawser is manned, and the cable hauled out to the boats and shackled to the anchor. The stream cable is then hitched round the shank, and seized and allowed to slip down to the crown; the stock lashings are cast off, and the anchor is let go, with the ring towards the ship, by a jigger on the lanyard of the toggle.

483. To find the Number of Casks requisite to carry out a 90 cwt. Anchor.—A butt holds 110 gallons, and a gallon of water (distilled) weighs 10lbs.; therefore, 110 × 10 = the floating power, 10 cwt. nearly.

The weight of the casks themselves need not be considered, as when they are submerged it is inappreciable. The anchor loses nearly 12 cwt. by immersion; and eight butts should be *sufficient* to support it, though doubtless ten would be safer.

A spar (spare jib-boom) would be required to secure the casks to. They should be whipped over ready slung, and placed at each end, and in pairs on each side of the spar, leaving the centre clear for the anchor. Hang it by the ring with a small lashing round the spar and ends of the stock, to keep the latter fore-and-aft. Cast these off before letting go. If the water be very shoal, or circumstances otherwise unpropitious, it may be necessary to sling the anchor flukes forward; in which case it will be hung by two lashings,

instead of one—a disadvantage when the operation of letting go is performed with an axe.

484. To calculate the Capacity of a Cask.—Multiply half the sum of the areas of the two interior circles, viz., at the head and bung, by the interior length, for the contents in cubic inches; which divided by 277·27, the number of cubic inches in a gallon, reduces the result to that measure.

Supposing that the casks at your disposal measured 21 inches in diameter at the bung, 16 inches at the head, and 28 inches in length; then 346·4 and 201·1 would be the respective areas, and their half sum—547·5 multiplied by 28, and divided by 277·27, would give 27·65 gallons for the contents, which is the capacity of a beef-barrel.

485. To ascertain the number of 4-ft. Tanks requisite to carry out the same Anchor.—The cubic contents of the tank being 54 ft., and a cubic foot of (distilled) water weighing 1000 oz., or $62\frac{1}{2}$ lbs.; $64 \times 62{\cdot}5 =$ floating power, minus the weight of the tank (which in water would be about 6 cwt)., or 30 cwt, nearly. Three tanks, therefore, would be the number required.

486. To calculate the Floating Power of Spars, for the same purpose.—Try the three spare topmasts; the main being 64 ft. long (exclusive of mast-head); diam. 22 in.; fore, 57 ft., diam. 22 in.; mizen, $45\frac{1}{2}$ ft, diam. 17 in. The weight that they will sustain, is the difference between their own weight and that of the water they displace.

To ascertain the weight of a spar: multiply the square of the diameter by ·7854 (the area of a circle whose diameter is one inch), to find the area; multiply the area by the length to obtain the cubic contents; and the product by the weight of a cubic foot of the material, ascertained by experiment.

Main topmast.—The greatest diameter being 22 inches, the proportion of diameter at 1st quarter is $\frac{60}{61}$; 2nd quarter, $\frac{20}{21}$; third quarter, $\frac{8}{9}$; equal to 22 in., 21·6 in., 20·9 in., and 19·5 in. respectively; consequently 21 in. is the mean diameter.

64 ft. = 768 in.; and $21^2 \times ·7854 \times 768 \div 1728$ (the number of cubic inches in a foot) = 154 cubic feet.

Fore topmast—57 ft., in like manner gives 137 cubic feet; and

Mizen topmast—45·5 ft., with a mean diameter of 16·2 in., is equal to 65 cubic feet.

Total, 356 cubic feet.

356 × 64·1 (the weight in lbs. of 1 cubic foot of salt water)	...	= 22819 lbs.
356 × 36·3 (the weight in lbs. of 1 cubic foot of Norway spars)	...	= 12923 „
Floating power of spars	...	9896 = 88 cwt.

487. Out Stream anchor and Cable.—Drop the launch alongside; put the gear into the lumber irons; unship the rudder, as you will steer with an oar, and see luffs, strops, and davit in the boat ready for weighing, and lead and line for sounding. Lay the ends of two capstan bars over the

stern, spread out, and rest the other ends on another capstan bar placed athwartships over the gunwhale. Clear away the anchor in the chains, stop the yard-tackle in with a strop round the pendant, bend on a fore-and-after from the gangway, lift the anchor out with yard and stay, stock it with a whip and burton from the main yard, reeve the buoy-rope double through a block on the crown for weighing, and lower it down with the stock athwartships, resting on the capstan bars, and the flukes up and down the stern. In the meantime the end of the cable has been passed up, taken from the hatchway round the fore bitts, and so walked round, instead of being roused up by standing pulls from the hatchway to the port. Coil the cable away on the top of the thwarts, stopping the last fake outside the boat under the rowlocks, in preparation for letting go, as cable equal to the depth of water must be payed overboard before the anchor is dropped, to prevent the gunwhale being torn away. Send boats ahead to take the launch in tow, and shove off. When required to let go, cut the stops of the cable outside, stream the buoy, and ease the anchor over on the capstan bars by lifting the crossed ends.

If a wire hawser is used it is usual to put it in the boat on its reel.

To weigh the stream anchor in a launch, ship the davit in the stern of the boat; lift the cable over its ends and clap the double block of a luff on the cable, and the single block is hooked to the bows of the boat; it is best to use two luffs fleeting them alternately, and if the anchor is hard to break out, put one luff on the fall of the other.

It is best to weigh the anchor by the buoy rope, making one part fast as a standing part, and treating the other part as above.

488. Cutting away Masts.—You first pass a hawser outside the lanyards of the rigging on the side you intend the masts to fall over. If the port side, cut away the mast on the starboard side, as high as you can, for the stumps will be of service in securing your jury-masts; and, when you have weakened it sufficiently, cut away all but a pair of shrouds on each side—guided by circumstances; then get out of the way and cut away the remaining starboard rigging, keeping fast the stays till the mast has fallen, when you free them immediately, and cut the port pair of shrouds adrift, which you will be able to get at, by their being kept up by the hawser.

If all three masts are to go, commence with the mizen-mast, and work forward; although, when at anchor, it is generally not advisable to cut the mizen mast away, as it is of great service in keeping the ship steady, head to wind.

489. Anchoring with Guns.—You have still your guns left and, having hauled in each cable as it parted, shackle them altogether, point the end out and haul it aft, outside, by a hawser passed forward. When aft lash the end with a good cross-lashing to the muzzle of the aftermost of the guns you intend to use, and also to the neckring and at the same time get on lashing the remainder in the same manner, allowing a drift of cable between each, equal to the depth of water, in order that the first gun going down may not tear the others out of the ports: and, commencing aft, heave them overboard without loss of time.

Should you have the good fortune to weigh them again, hook on the cat as they come up to the bows and get them in through the bow port, if it will admit of its being done. By having a good drift between each, you will only have the weight of one at a time to heave up.

Should the guns not bring her up, you may be able to select the spot at which to go on shore, by getting up a short pair of sheers, setting a staysail on them, and slipping the cables.

To heave a gun overboard.—Cast loose, lay the gun horizontal, and ease her out, so that the muzzle may be just clear of the inside of the port. Hook two side-tackles to the housing bolts, and to a short strop under the neck, haul them well taut and keep them manned. Hook a train-tackle to each rear loop, and to the train-tackle bolt in the deck, haul taut and attend them. Unreeve the breeching, place a capstan bar on the steps of the carriage on each side, with the small ends under the gun, ready to elevate. When ready, throw back the cap-squares, look out for the roll, and at the order "Heave and haul," haul upon the side tackles, heave on the capstan bars, and ease the carriage out by the train-tackles, the port being hauled up at the same time. In iron-clad ships none but upper deck guns could be thrown overboard through the ports, owing to the small size of the latter.

In the event of a ship getting ashore, and having to heave her guns overboard to lighten her, they should be slung by a single part of the breeching, for weighing; the clinch secured to the button, and then lashed out to the muzzle; using a breast-frapping for a buoy-rope and a truck for the buoy.

The reviser at first fully intended to erase the foregoing answer, but on second thought determined to retain it, as it may perhaps occur, that a ship should be obliged to use guns in place of anchors; though under the circumstances detailed he would feel more inclined to select the softest spot on the beach.

490. In expectation of being fouled by another Ship.—Send hands aloft to drop the foresail, put the slip on, unshackle the cable, bend on a hawser, and, as your friend approaches, off slip and give him a wide berth. In a fresh breeze, stand by to veer instead of unshackling.

If collision be unavoidable, get the swinging boom alongside, lower the quarter-boats and ports, overhaul lifts and trusses, and brace the yards up on the tack opposite to the side the ship is on.

491. Anchoring in a Boat on Rocky Ground.—Bend the cable to the crown of the anchor, and stop it to the ring before letting go. Should the anchor catch when you weigh again, a heavy strain will come on the stop, which will carry away, and enable you to break out flukes uppermost.

492. Hawse-pipes Broken.—Knock them out; place starboard pipe in the port hawse-hole, and port pipe to the starboard one. Slue them round, to bring the underneath and damaged part uppermost, and drive home. Cut the inner edge off flush where they overlap.

Chapter XIII.

MISCELLANEOUS.

493. Coaling Ship.—A practical example of successful coaling by H.M.S. Magnificent is given, showing the method employed in that ship and the amount of coal taken in &c,

Four Derricks are used.

1.—Wooden Derrick length 30 feet on the Forecastle before the Battery supplied for coaling purposes, it is fitted with two wire whips reeving through blocks one secured to head, and the second a few feet below it, an outhaul block travels on each whip, the end of the latter is spliced into a hook and the other end reeves through the outhaul block, through the block on the Derrick Head through a leading block on the forecastle of the collier to the collier's winch.

The outhauls are worked from the far side of the collier, and reeve through blocks on the collier's derrick and are spliced into the outhaul block travelling on the whip.

2.—Wooden Derrick abaft fore bridge length 45 feet supplied for hoisting in or out "small boats" it is fitted with two wire whips reeving through blocks on the derrick head, one end of the whips is fitted with a hook the other end is brought to its respective coal hoist on the uper deck of the Magnificent. In the collier, two whips are fitted to the

collier derrick, placed so as to plumb the hold, one end of the whip is spliced into the hook on to the end of the inboard whip and the other end is brought to the collier's winch.

3.—Steel derrick supplied for hoisting in or out "Boom Boats."

This derrick carries the Temperley Transporter, which is hooked on to the lower purchase block, the wire of the Transporter leads through a leading block on the after shelter deck over a roller (forming a bight) and the standing part is secured to the shelter deck, a block is fitted on the bight of this wire, and a $3\frac{1}{2}$ inch wire pendant is spliced into it, this is brought to the after capstan and the wire on the Temperley works at double the speed of the capstan.

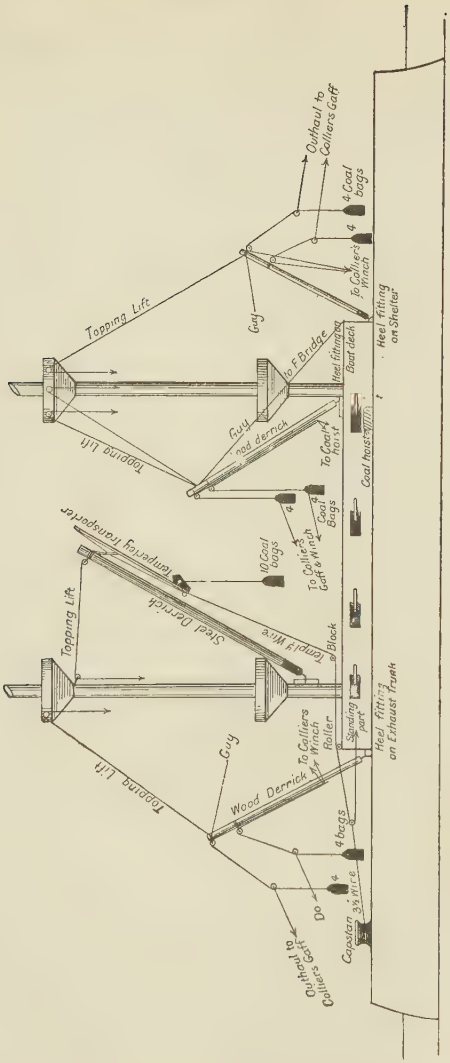
4.—Wooden Derrick length 30 feet fitted on the Quarter deck abaft the battery and is supplied for coaling purposes.

The derrick is fitted and the whips worked in a similar manner to No. 1 derrick on the forecastle.

A wire hawser is fitted from the mastheads, forward and aft, with two whips on each as an alternative in case of either derrick being disabled.

A whip is also fitted to the main derrick head as an alternative in case of the Temperley Transporter being disabled.

The arrangements adopted can be seen in the attached figure.


Outhaul to Colliers Gaff
4 Coal bags
To Colliers Winch
Heel fitting on Shelter
Topping Lift
Guy
To F Bridge
Heel fitting Boat deck
Guy
rod derrick
To Coal Hoist
Coal hoist
Topping Lift
10 Coal bags
To Colliers Winch
Coal Bags
Temporary transporter
Steel Derrick
Topping Lift
Temp'y Wire
Block
Heel fitting on Exhaust Trunk
Standing part
To Colliers Winch Roller
Guy
Wood Derrick
Topping Lift
4 bags
Do
Capstan 3½ Wire
Outhaul to Colliers Gaff

335

Stations of the Ship's Company coaling, collier being fitted with four holds.

Fclemen. Work the foremost hold and fore derricks.
60 men in collier's hold divided into 8 gangs.
18 „ attending whips, outhauls, unhooking bags, &c.
6 „ returning empty bags.

Foretop men. Work the second hold and derricks.
60 men in collier's hold divided into 8 gangs.
18 „ attending whips, guiding bags through hatch on skid deck.
6 „ returning empties.

Maintop men. Work the third hold and Temperley Transporter
72 men in the hold divided into 4 gangs.
3 „ unhooking bags.
8 „ returning empty bags.

Quarter Deck Men. Work the after hold and after derricks.
60 men in the hold divided into 8 gangs.
18 „ attending whips, outhauls, unhooking bags, etc.
6 „ returning bags.

Forty-one marines, assisted by nine other ratings, employed in wheeling the coal away in barrows to the bunkers.

Nineteen marines employed in placing the bags on the barrows and tipping.

Fourteen daymen employed tipping the coal into the bunkers.

Sailmaker and one hand employed repairing coal bags.

Five chief stokers, 9 leading stokers and 102 stokers employed :—One chief stoker, 8 leading stokers and 40 stokers for trimming the coal in the different bunkers and the remainder employed closing the

armoured doors, driving the winches, weighing and tallying bags.

The following is the statistics of coaling at Vigo, from the collier "Pontypridd," on the 29th November, 1898.

She was fitted with 4 holds and 775 tons were taken on board.

Coaling commenced at 8 a.m., and finished at 12.50.

Number of Bags taken in per hour.

Hr. a.m.	Fcle.	F. Top	M. Top	Up. Dk.	Tl. in Tns.
8—9	276	373	286	402	131
9—10	366	381	416	404	156
10—11	401	476	428	400	175
11—12	397	445	430	386	174
12—12.50	337	381	360	322	139
	1777	2056	1922	1914	775

Average per hour 160·4 tons.

The fore top or the 2nd hold in the collier is usually the best. The forecastle hold is invariably the worst to start, especially when breaking bulk as in above case, the hatch being small. The third hold is usually the same, consequently at first there is little room for the men to work.

With good open holds 45 to 50 tons ought to be taken in per hour from each part of the ship.

The number of coal bags used in the above was 400.

" " shovels " " collier " 120.

" " barrows " on board was 50

X 337

494. Knot in a Hawser, under the Circumstances described.—Open it out, and pass the boat through it. This actually happened in a ship that I belonged to.

495. Canvas Tanks—Are supplied to nearly all ships, and are made to fit under the thwarts of a launch, it is a much cleaner and safer plan than watering in bulk, although the boat will not bring quite so much water on board at a time. The tanks when done with, are usually run up by a whip on the foreyard, until dry.

496. Bringing off Water in Bulk.—See the boat clear and free from leaks. pump some fresh water into her the night before, but dry the boat out before sending her away; and keep the bottom boards, and a few oars or thwarts loose in her, to prevent the water surging about when she is loaded.

497. Rafting Water off.—Knock the outer hoops off each end of the casks, and drive them on again with a becket underneath, for a hauling-line to pass through between the beach and the boats anchored outside the surf. If not worth while to fit beckets, you may sling the casks instead. Parbuckle them into the boats, over the stern, if the water is smooth, and pull on board.

498. Boats' Rain-awnings.—Fit three or four stretchers for each side, to step in the bottom of the boat, lash down to the gunwale, and project two or three feet beyond it. Through a thimble seized to the end of the outriggers, or through a hole bored in them, reeve the ridge-rope, and set it taut up. Then haul the awning out to the stanchions

(which must be of good height), and the side stops to the ridge-rope. It may also be worth while to fit a curtain in addition.

When the rain is over, and the awning made up, this ridge-rope, with the outriggers kept fast, forms a capital clothes-line for drying your wet things on, and ought not at any time to interfere with the oars.

499. Boat standing for the Ship and unable to fetch up.—The safe plan is to send a boat away with a small hawser to meet her, and then haul up both together, giving way at the same time. This saves a vast amount of trouble in the end, for, when a boat-rope is veered by a breaker, it requires buoying up at intervals to keep the bight from sinking, and even then will be carried very slowly astern—to add, probably, another proof to the universal proposition, that *half-measures are always failures.*

A small coir hawser should be kept (with a breaker attached to it) aft, on the upper deck of every ship, it will be found to save endless trouble with boats in a tide-way.

500. Caught in a Fog, after towing a Ship out of Harbour.—Go on board the ship you have been towing, and take the bearing of the harbour, which you know from the course you have been steering; note the relative direction of the wind, if it is steady, and shove off, keeping it on the same bearing till you get inshore or fetch the harbour. Should there be no wind, form the boats in line, standing for the harbour, when, if each boat keeps in the wake of his leader, the leading boat will be enabled, by keeping the line directly astern of him, to steer a straight course for their

destination. The soundings, also, will tell you whether you are approaching or pulling away from the shore; and if the ship will heave to, and fire guns at intervals till you have time to get in, you cannot well go wrong.

501. Sent away to set Fire to a Ship or Buildings.—Take with you a lighted slow match, and a port-fire. (A port-fire requires scraping on the top, but you can ignite it with a slow match.) If you are away without either, the quickest way of making a fire is by mixing a couple of cartridges up into a *devil*, and setting fire to it by means of a piece of paper, smeared over with wet powder, fired out of a rifle with a half charge. A primer with a piece of this touch-paper attached to it, will ignite the latter if struck against anything hard, when the report of the rifle would be inconvenient.

502. A Gale of Wind in an Open Boat.—Lash your masts, bottom-boards, and oars together; hang the boat's anchor to them, to weight them; span them with the boat's hawser, and pitch them overboard. This will not only keep you head on to the sea, and form a breakwater, but will prevent you drifting so fast. Pass the other end of the hawser round the boat outside, guy it down here and there, by passing the bight of a rope over the bows, and slipping it aft under the bottom; lay the sails over the fore part of the boat, and lace them down outside to the hawser; raise the after part up a little by sticking a stretcher up under it, and you will thus keep the seas from breaking into the boat, and have a shelter from the weather. Bung the breakers well up, run a piece of rope through the beckets to form a life-buoy, and keep the boat baled out.

503. "WATER, WATER, EVERYWHERE; AND NOT A DROP TO DRINK."—Twice a day dip your clothes overboard, and put them on wet.

504. LANDING, AND GETTING OFF IN A SURF.—Pull up to the rollers, and, if you are not going to beach her, let go the anchor, back astern and go in after the third, which is the heaviest one, jerking the looms of your oars down to keep the blades out of the water. Let those who intend to land jump out as soon as possible, toss your oars in, and haul out through the surf before the next heavy sea comes in; if you are going to remain, go in of course bow first, jumping out and hauling the boat up before a sea comes over the stern and fills her. A steer oar through a grummet in the stern-ring should be used, as the rudder cannot be relied on. The best surf-boat is a whaler *with paddles*.

505. TRACKING.—Land all but one hand to steer the boat: pass your grapnel out, and track her up. If you have far to go, make tracking belts to go over the shoulder, of any small stuff you may have in the boat, and hitch them to the boat-rope;—slipping the bight into the foremost rowlock, if, from the shallowness of the water, it is necessary to track at a broad sheer.

506. CAUGHT IN A SQUALL.—Down with the helm and throw her up into the wind, without waiting for the sheet to be let go, although there may be a hand attending it, then lower away and reef.

507. Fire-arms.—Before returning on board, be most particular in seeing all the rifles unloaded ; for innumerable have been the accidents resulting from passing loaded fire-arms up a ship's side.

508. Hoisting Bullocks in.—Hook on the yards and stay to a strop round the beast's neck, putting his fore leg through it to prevent it choking him. Cattle should be hoisted in by the horns only when the latter are very strong, and the animals themselves very small.

509. Hoisting Horses in.—If troublesome, cover his eyes, hobble him, and sling him with a broad mat, or canvas slings, under his belly ; with a crupper from his haunches round the chest, to keep the slings from shifting. Lead the halter through a ring-bolt on deck, and take the slack through as he comes in. A strop round the nose, hove taut with a short stick or toggle, will rapidly tame an unmanageable horse.* Horses should be kept slung in their stalls at sea, with their hoofs just resting on the deck.

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* To see how defective all rules and specific directions may be, unless seconded by mother-wit and dexterity, read this Crimean anecdote of an embarkation of horses on board the "Ganges."

"One horse," writes the 'Staff Officer,' "would not allow the slings to be put under him, and kept on lashing out with one hind leg in a most furious manner (it was too rough for him to kick with both, as he would have fallen). This beast was delaying the embarkation of the other horses ; so one sailor called out, 'Jack, next time he kicks lay hold of his leg!' which Jack very coolly did, and, to our utter astonishment, the horse stood perfectly still, and only snorted ; in another second he was swinging in the air, half-way up the ship's side.

510. Up-ending a Large Cask.—Lay a capstan bar under the bilge on each side, span them together under the chines of the cask, at each end ; man the bars, and up with it, sticking to it on the opposite side to prevent it going over.

511. Condemned Rope.—Is returned into store in five-fathom lengths.

512. Mounting a 64-pr. Gun with its own Tackles. —The side and train-tackles supply you with nearly thirty fathoms of three-inch rope, which is capable of supporting a weight, *suspended to it*, of 50 cwt. Therefore, if it is possible to apply the power necessary to lift the gun to three parts of rope attached to it, there can be no doubt of their capability to sustain it, more especially when applied as a parbuckle.

If the gun is lying with the vent up, scoop the earth away from under one of the trunnions, and roll it over with the vent down. Lift the carriage on the top, lock the cap-squares, reeve and middle the breeching, pass the ends over the rear axle tree, and secure it so as to confine the breech to the carriage; then haul over the latter on its flat. Hitch the side-tackles to the upper fore axle-tree, and the train-tackle to the rear-axle tree, and reeve them under the carriage and over the gun. Clap on all three parts as many hands as can get hold of, assist with the handspikes on the opposite side and rouse away, chocking her up with stones at every inch you get.

Although there are now no 64 pr. guns in the service, the above has been retained as a general indication of a method that might be adopted under certain circumstances.

513. Getting a Gun up a Height.—Dismount the gun as you mounted her, easing her over by a hawser passed the opposite way, and landing the breech and muzzle on some large stones to keep her off the ground. Then unlash the carriage, and wedge the gun up in a cask, woulding staves round it beyond the cask, and making it as round as possible. Parbuckle it up with the hawsers, and haul the carriage up afterwards.

514. Placing Heavy Guns in a Launch for landing. —Cut a spar or oak plank, to lie on the gunwale inside the upper streaks, over the after-thwart; and place a couple of spars fore-and-aft, resting on this and on the stern. Land the guns athwart these, and stow the carriages and gear forward.

515. Mounting them with a Small Triangle or Gyn.—Hook the tackle to a strap through the neck-ring, and weigh the breech off the ground high enough to allow the carriage to be run up with the trunnion-boxes under the trunnions, the muzzle still resting on the ground; then lower away roundly, and the gun falls into its place.

516. A Parbuckle—May be worked on the bight, or on the end.

On the Bight.—Middle the hawser, pass the bight under the gun, haul back and slip it over a fixture; open the ends out under the gun, to keep it square, and walk away with it.

On the End—When you have nothing to make the bight fast to in the direction in which you want to move the gun, middle the hawser (or less, according to the distance to be moved over), and take two or three turns round the gun

amidships; then let a few hands hold back on the underneath end, which is taken up as the part you haul on comes off,—the hands that hold on the end following the gun up at the same time. Skids must be laid along, to keep the trunnions off the ground.

When a gun has to be taken a considerable distance, slue it, vent up, bend on to the neck-ring, and clap on plenty of hands.

517. Fighting a Gun without a Carriage.—Rig a triangle, sling the gun round the trunnions and over the button, hooking on the purchase so as to give the required elevation, in which it has an advantage over a carriage, inasmuch as there is no limit to it. To check the recoil, reeve the breeching through a block or thimble on two legs of the triangle, with a large net full of shot slung to the ends. Sheer-head guys will perhaps be found necessary.

Otherwise, build the trunnions up, and regulate the elevation by a small triangle over the breech. But by this plan you can only fire at a fixed object, as the direction cannot be altered.

518. Landing Field-piece for Exercise.—Haul the boat up alongside, and place the large end of a capstan bar on the gunwale on each side of the stem, projecting a foot or two over, the inner ends being secured. Hoist the gun out ready mounted, on the field-carriage, and land the axle-tree across the capstan bars, outside the stem, with the wheels on each bow. Bear down on the trail, and lash it to a thwart Place the limber in the stern-sheets, and afterwards hoist the boxes over.

On reaching the shore, land the field-piece party, hook on the drag-ropes and man them, launch the capstan bars out, and plant them as skids, lashing the inner ends to prevent them slipping. Bend a rope's-end to the trail to ease it down by. Haul away on the drag-ropes handsomely until the wheels take the ground, and then run the gun up. Pass out the boxes and land the limber.

519. In the Face of an Enemy.—Fight the gun on its slide in the boat as long as it is available, land the covering party, cease firing, in tompion and vent-plug, unreeve the breeching, slip a short strop over the breech and another over the muzzle, bringing them together at the trunnions, carry aft the runners of the foremast, top the bowsprit up for a derrick (previously fitted for that purpose), hook a tackle from the derrick-head to the strop, bend a drag-rope to the breech-ring, whip the gun out, drag it ashore and mount it. Hands in the mean time have got the carriage and limber ashore and ready, the wheels having been slung outside the boat, the trail and limber fore-and-aft, and the boxes in the stern-sheets.

Boat-keepers haul the boat off to her anchor, leaving a line ashore to haul in by when wanted.

520. Hoisting in Guns.—The gun you wish to hoist in is an 8-inch, and weighs 9 tons. Top the main yard, and brace it, so that it will plumb the port or hatchway through which the gun has to go; put the burtons on the yard as preventer lifts, haul the lifts, preventer lifts, trusses, braces, and topsail sheets well taut, lash the bunt of the main yard, to the mast with a cross lashing, hook a luff tackle on the opposite side to the rolling tackle strop, and to another strop

round the mast, haul it taut. Lash a top block on to the yard far enough out to allow the gun to clear the ship's side while hoisting; take the end of a 7-inch or 8-inch hawser from the opposite side of the deck over the lower cap, and through the block lashed on the yard, then take the end on deck and secure to it the upper block of your yard purchase, round it up sufficiently high, and secure the hawser on deck, well parcel the hawser in the wake of the cap, and wherever it is likely to chafe.

For both yard and stay purchases, two three-fold blocks must be used, with five or six inch falls rove in them, the hauling parts should be led through leading blocks at the mast-head before going on deck; top-tackle blocks can be used for the purchase blocks.

The gun is slung with a chain strop, having a seizing on one bight, leaving an eye large enough to fit over the button of the gun; the other bight to which the purchase blocks are hooked, is well lashed to the gun outside the trunnions.

The main hatchway of ships carrying heavy guns on the main deck, is generally fitted with movable combings or iron plates, that fit across the hatchway, allowing the carriage to be placed so that the gun can be lowered into it at once; great care should be taken in transporting the gun to its port, or you will find the deck much cut up by the iron carriage.*

For guns under $6\frac{1}{2}$ tons in weight, secure the main yard as you would to hoist in a launch. Reeve the end of a top

* To hoist in heavier guns, see answer number 532.

tackle pendant through a top block, take the end over the lower cap and secure it on deck, lash an up-and-down tackle to the main yard arm, and to the top block on the pendant to be used as an out haul; reeve a top-tackle fall, hook the upper block to the pendant, and lead its hauling part through the leading block on the strop of the upper block: through another at the cap, and then on deck.

To get the Gun in through a Port.—When slinging the gun, allow a good drift outside the lashing, to give play to the gun when the purchase block binds against the upper port-sill; line the port, to prevent injury to it, hook the purchase, and hoist away. When up to the port, case in the up-and-down, pass the gurnet out, and hook it to the neck-ring, haul in on the gurnet, ease away the purchase, and land the gun on the carriage run up to receive it. Unhook, and overhaul down for the next.

The gurnet—consists of a pendant and tackle, and is best fitted so that it can be worked under the eye of the officer superintending the mounting, and for this purpose, a clump-block with a double strop should be fitted, and the bights either slipped over the dismounting bolts, or toggled through the deck. The end of the pendant is fitted with a hook or shackle to take the neck-ring of the gun.

Boats' guns are slung with their breechings, and hoisted in with the yard tackles.

521. To Calculate the Weight of a Gun.—Rule; Divide the gun into as many sections as its form requires, to enable you to obtain the true dimensions, and ascertain the weight of each part separately. To do this:

1st. Find the area of the base of the cylinder, by multiplying the square of the diameter by ·7854; or by multiplying the square of the circumference by ·07958.

2nd. To find the solidity of the cylinder, multiply the area into its length.

3rd. Add the contents of each section thus found, for the whole contents of the cylinder, supposing it to be a solid mass.

4th. In the same manner find the contents of the bore of the gun, assuming it to be a solid cylinder.

5th. Substract this from the solid contents of the gun, previously found, to obtain the actual contents, and—

6th. By Table, obtain the weight of a mass metal of the dimensions ascertained.

$7{\cdot}125^2 \times {\cdot}07958 \times 8{\cdot}5 = 34{\cdot}34$ ft. Contents of 1st section, from base to trunnions.

$6{\cdot}146^2 \times {\cdot}07958 \times 11{\cdot}333 = 34{\cdot}06$ ft. Contents of 2nd section, from trunnions to muzzle.

$·75^2 \times .7854 \times 19{\cdot}833 = 8{\cdot}75$ ft. Contents of bore.

$68{\cdot}4 - 8{\cdot}75 = 59{\cdot}65$ ft. Cubic contents of gun.

$59{\cdot}65 \times 524{\cdot}8 + 5$ cwt. $= 14$ tons, $4{\cdot}5$ cwt. Total weight of gun.

522. To find the Solid Contents of a Sphere.—Multiply the cube of the diameter by ·5236; or the cube of the circumference by ·01688, and, by Table, find its weight.

$8{\cdot}7^3 \times {\cdot}5226 \times 4{\cdot}171 = 90$ lbs. Weight of the shot.

523. GETTING MAIN YARD FORE-AND-AFT THE DECK.—Coming down port side. The ordinary plan is to top yard to starboard, by a sail-tackle from the topmast-head, hauling forward on the preventer brace and lowering the jeers, to clear the top rim ; hauling aft by mizen burton to port yard-arm, and then with a luff on starboard yard-arm, rousing it over into the gangway, when lowered clear of the main stays.

In a ship with short lower masts, it may happen that there is not sufficient drift for the yard-arm to come in over the nettings or through the gangway ; in which case, having rove the jeers, unrove the after braces, unbent the sail, and sent the booms down, you hook a tackle to the bunt of the yard from the starboard side of the forecastle, and, alongside it, a runner and tackle from the foremast head, the pendant being taken under the top, and secured close down to the eyes of the rigging. To a strop round the starboard yard-arm hook the port up-and-down inside the quarter-iron, and outside the quarter-iron, on the port yard-arm, hook the port main tackle : these support the yard-arms when fore and aft and the lifts are unrove. From the port fore rigging, hook a burton to the starboard yard-arm, where the fore tackle is attached. Then heave taut the jeers, off slip, turn out the trusses, and lower the yard partly down, rousing it bodily forward by the runner and tackle, and bracing the starboard yard-arm inside the fore rigging by the burton and preventer brace ; turn with the runner, walk back the jeers. and haul forward on the fore-and-after till the port yardarm is clear of main rigging and main mast, attending, at the same time, to the fore and main tackles ; rouse the yard-arm over by a luff, lower of all, and land the yard, allowing it to come aft as far as convenient.

524. Unbending Sails.—Words of command.—"Unbend sails." "Away aloft." "Lay out on the lower yards and unclamp." (Laying in again.) "Trice up—lay out" "Ease in." "Stand by booms and buntlines." "Sails and booms—lower away."

If top-gallant and royal yards are across, yards, sails, and booms may be lowered together.

525. Shifting Bowsprit Cap.—Rig the jib-boom three-fourths in, and pass a lashing round the head and heel to keep it in its place when the cap comes off; pull up on the sail-tackle (from mast-head to boom-end), to take the weight of the cap when it is started: unreeve the heel-rope, sling a spar on each side of the bowsprit, lash a couple of leading-blocks to the jib-boom, close to the cap, and through them reeve a rope's end to the heel of the spars; with these, bump the cap off the bolt, which secures it to the bowsprit (fore-locked on the top, abaft the foremost hoop), being driven out; carpenters assisting with their mauls. When off, sling it, rig the boom in altogether, and hoist the cap in with a couple of luffs on the fore stay, the sail burton taken off the boom, and with the fore up-and-down.

Or, it may be got off by dropping a pair of sheers formed of topmast studding-sail booms, supported by a sail-tackle from the mast-head, the heels stepped on the bees, and the cap slung, while being bumped off, by a couple of luffs from the sheer heads; and transported in as before. In this manner, it may also be sent out, and placed again.

The jib-boom may be used for getting the cap on, by resting the heel against the stem, topping it up with the sail-

burton, and swaying the cap up by a tackle from the boom-end.

Or, it may be sent out as far as the collars of the fore stays by the luffs, and there lashed to a topmast studding-sail boom pointed through the round hole; a guy on each side taken to it from the cat-heads, the sail-tackle hooked to the end of the boom and pulled up, and the boom rigged out by heel-ropes—easing the guys and sail-tackle.

526. SHIFTING BOWSPRIT.—A bowsprit may be got out either with a derrick, or with sheers. If by the latter means, strike the fore topmast and land it on deck; get the spare one up alongside of it by up-and-down; open out the heel—resting on shoes, cross the heads and lash them. Secure the foremast with runners and tackles, strip the bowsprit, and house main and mizen topmast. (In a corvette use two jib-booms as sheers). Lash a top block to the sheers'-head for the topping-lift, and a couple of blocks to the foremast head just above the rigging, so that they will clear the top when the topping-lift is rove, using for it a 7-inch hawser, with the standing part secured to the sheers'-head.

Lash a three-fold top-tackle block at the sheers'-head, and reeve the main jeers for a purchase, the lower block being either a top-tackle or a cat-block. Secure the pendant of the launch's purchase to the foremast head, lead it over the sheers'-head, so that the block will be close up when they are drooped and lash it out on the bowsprit ten or twelve felt inside the cap, for a cap purchase, a turn or two of the lashing being taken to the cap, to prevent it slipping in. Lash the purchase out between the gammonings; two or three of the turns round

the bowsprit should not be taken over the hook of the purchase block, in order to jamb the lashing. Mark the bowsprit where the sheers'-head should plumb when drooped sufficiently, which should be as far outside the lashing as the bowsprit houses inboard. Haul forward on the purchase and droop the sheers till a plumb-line from the purchase block comes over the mark on the bowsprit. Lead the fall through a leading-block hooked to a lashing passed over a toggle inside the hawse-hole and long enough to allow the fall to lead fair, through the main deck bow port to the capstan. Bend a rope's-end, through a block on the cat-heads, to the man-ropes, for head-guys; hook a luff to the bowsprit from the head-knee, close to the stem on each side to assist in clearing the heel by hauling out if necessary—slipping the strop down as the bowsprit goes out; also in the same manner, hook a luff from the bows on each side, to steady the heel when swayed out.

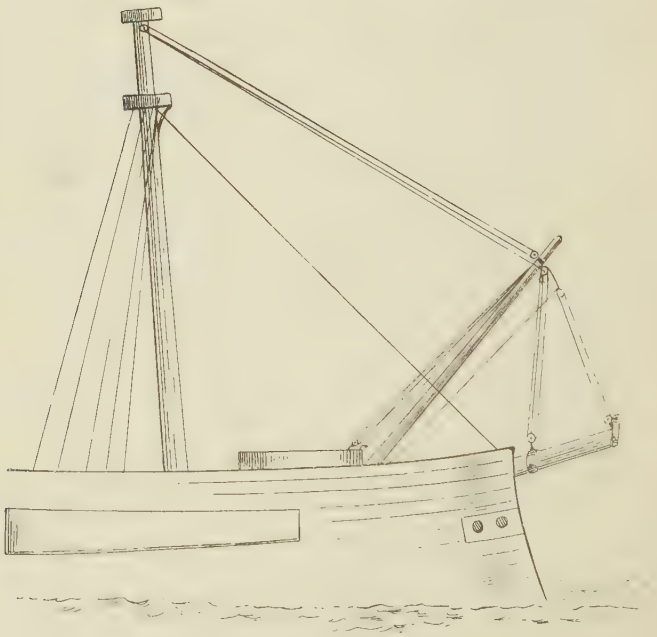
The heel-lashings should be passed only temporarily till the sheers are drooped, and then lashed properly; and the space between the upper part of the heels and the deck should be well wedged up and attended to.

Knock out the wedges, and, when ready, heave round on the purchase, easing the cap purchase as the mast goes, out, and keeping it from binding in the bed.

Get the new bowsprit in by the same appliances attending to the directions given in Art. 3.

H.M.S. "Temeraire," when paying off in June, 1891, got her bowsprit out with a derrick in the following manner:—A jib-boom was used as a derrick and stepped just before the

Barbette, the main purchase consisted of the fish fall rove through two double blocks, the fall being led through a leading block at the derrick head and then through a block at the foremast head ; the cap purchase was a yard tackle, with the fall led down on the forecastle ; a top tackle pendant and fall was used as a derrick topping lift, the pendant was rove through the top block at the lower cap, then through a block at the derrick head, and secured round the lower mast head, the top tackle purchase being used as usual ; two sail tackles were used as derrick guys, and set up to the catheads ; a luff



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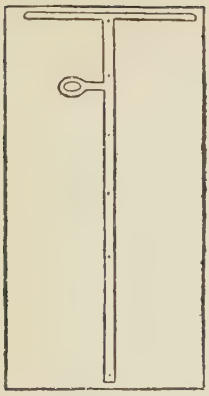
was used as a derrick martingale. The main purchase was lashed to the bowsprit as close to the bows as possible, but as the bowsprit was too long to get out on one pull, it was hoisted out as far as possible, held by the cap purchase, the heel wedged and secured, and the main purchase then fleeted in again. The weight of the bowsprit was about 4 tons.

527. Hoisting in a long Spar.—Trice up yard and stay-tackles, cross the stays, and brace the yards in ; pull up the after end best, until the foremost end is inside the fore rigging, backstays being frapped in ; then lower the after end, and haul forward.

528. Hogging Ship.—Wedge a large grating full of broom stuff ; bend a weight to the bight of a hawser, and dip it under the ship's bottom ; haul up on one end and bend on the hog at the bight. Reeve a hawser, inboard, through a block on the bowsprit and spanker-boom ends, and bend the ends to the hog ; give the thwartships hawser into a boom-boat on each side ; and if the hog is over the starboard side, and you are going to hog that side first, let the port boat haul up on the hawser until the hog is brought close down to the keel, and, when down, and a taut turn has been taken in both boats, man the fore-and-after and walk it forward and aft the whole length of the ship. The port boat then eases up the breadth of the hog, the starboard boat takes in the slack the fore-and-after is hauled on, and another longitudinal section cleaned, and so on with both sides. By heeling the ship over, you may clean a short distance below the water-line by means of small hogs with poles stuck into them.

529. INTERNAL ECONOMY, &c.—HAMMOCKS.—As the neatness of the hammocks adds as much to a ship's appearance as their slovenly condition detracts from it, it is necessary that they should be carefully inspected by the midshipmen stationed to nettings previous to being stowed. To permit of this, the men on coming on deck, should fall in abreast of their nettings in the rear of each other, according to their numbers; the foremost hammock of each netting always commencing with the same number on the watch bill, and continuing consecutively, the men keeping rank, and closing up as the foremost hammocks are passed in. The first turn of the lashing should be rove through two holes in the tabling, close to the midship seam ; no wrinkles allowed in the head, nor in any other part of the hammock ; the ends of the nettles carefully laid along, and hitched over inside, and a twist taken in the clews and hauled taut along the hammock by the lanyard of the opposite clew. A hand should attend the gage while stowing; and the lashings of the waist hammocks should form one uniform line, inside and out, by being squared after they are stowed.

To insure regularity in the distance of the turns, and in the position of the numbers, an iron scale should be used like that in the cut. It is there placed on a starboard watch's hammock, and must be turned over to mark those for the port watch. Seven holes are punched in it, where it lies on the seam ; and when these with the oval for the number, are pencilled round, the scale is removed. A stitch or two is then passed through the seven dotted marks, which show,



when lashing up, where the turns should come; and the patch is painted with black numbers, on a white ground bordered with a black line, for one set of hammocks; and with white numbers, on a black ground bordered with a white line for the second set. Two good stops, whipped, should be spliced into the head of each hammock, and two in the foot, for stopping to the gantlines; the centre stop for the head being a fixture in the gantline.

When hammocks have a tendency to exceed their stipulated dimensions, a hoop is held for the hammocks to be passed through as they are stowed.

On piping down when hammocks have been covered, the men, after taking them below, should return on deck, and form in line round the ship facing the nettings, abreast of where their hammocks have been stowed, ready to man the nettings for furling, when they have been reported clear by the young gentleman stationed to them.

MIDSHIPMEN'S DUTIES.—While touching on this subject, I am reminded of a very laconic, but comprehensive summary, issued by the captain for their guidance, in a ship of some note.

"Their duties," it ran, "in one sentence, are to do as they are ordered in a smart and intelligent manner."

"They are to see all orders carried into effect. That the men are at their stations. That they perform the duties of their stations That all ropes are coiled down directly they are belayed. That all dirt or spots on the decks, are instantly removed. That rope-yarns or other rubbish, are removed from wherever they may have chanced to accumulate.

"When sent on duty, they are never to quit that duty. They are never to leave their boats, nor suffer any of their crew to do so. They are not to allow spirits or wine to be brought to their boats' crews; and are to report any man who may have misbehaved.

"They are at all times to appear properly dressed, and are to avoid incurring debt.

"They are constantly to keep in mind, that unless they conduct themselves to my satisfaction, they will not receive a certificate; without which, when the time arrives, they will not be examined touching their qualifications for a commission."

Furthermore, the officer of the watch is ordered by the captain "on all occasions to be most strict with the midshipmen, and is authorized to punish either of them by giving them an extra watch for any fault not sufficiently grave for him to interfere with." The officer of the watch is also directed "not to allow the midshipmen of strange boats to remain on board after they have delivered their messages, but to make them lie off, or hang on to the boom."

The first lieutenant is to "take care that they are kept strictly under instruction during school-hours; and they are never to have leave unless they are clear of debt, and unless they perform their duties in a diligent and attentive manner."

The character of a ship can always be told by her boats and boats' crews; therefore the officer of a boat should not only consider himself answerable for her cleanliness and good order, but that the crew are properly dressed, orderly, and respectful, and that they *always give way*,—setting the same example of respect to officers of other ships, as would be required of him and his men by those of his own. As a general rule, boats are better manned and cleared from booms, instead of from the gangways. Under ordinary circumstances, every man should be on deck in a minute from the pipe; and the first person up should be the midshipman of the boat.

As midshipman of a top, he should exert himself to maintain the most perfect silence; to see, in furling sails, that the men keep within the marks which should be painted on the yards, until ordered to lay out; and that as they come in off the yards, none land in the top except the men stationed there for squaring yards. As the booms should not be lowered until every man is in, he should see that the quarters of the yard are smartly cleared, to make way for the outside hands, with the exception of the yard-arm man, who remains out to foot the boom clear. In reefing, he should be particularly careful that the boom-backs and tricing-lines are properly attended, and are not started until every man is in. In crossing yards, and shortening sail, that the squaring marks of lifts are expeditiously got down; and, on all occasions, that a *second* hail from the deck is never necessary.

As midshipman of the watch, he is to have his watch bill always with him: and, as it should be a standing order that no man is to *walk* when called, working ship &c., so the

young gentlemen should at all times set the example of a like prompt and ready obedience. On the school a youngster is brought up in, his future character depends.

To mates of decks the following receipts may be of use :—

For Guns.—4 oz, resin, 2 oz. lamp-black, 3 oz. beeswax (2 oz. shellac), 1 quart linseed oil. Boiled 50 minutes and, when taken off, half a pint turpentine added.

This is to be laid on as a first coat, and afterwards kept up with ordinary bees-wax and turpentine. For bronzed guns omit the lamp-black, and previously apply a solution of sal-amoniac, after scraping.

Browning or rusting coat for guns.—2 oz. Tincture of steel 2 oz. Spirits of Wine, $\frac{1}{2}$ oz. Muriate of Mercury (Corrosive Sublimate), $\frac{1}{4}$ oz. Sulphate of copper, $\frac{2}{3}$ pint of boiling water the above well mixed will be enough for a 6 inch B.L. gun. The gun must be first perfectly cleaned and free from any trace of oil, a wash down with oxalic acid is a good thing.

Put on the mixture *coiled.*—Stand for 3 hours, then pour boiling water over the gun, as soon as dry then again put on the mixture carefully coiled, and let the gun stand for a day. Then polish with 2 parts of linseed oil and 1 part of Kerosine with a little methylated spirits mixed ; the first coating to be all rubbed off again so as to clean the dirty rust off the gun.

N.B. A good coat will not be obtained unless the gun is perfectly clean and free from oil in the first place.

White varnish for range-tables, &c.—White resin and turpentine, dissolved in a close bottle, placed in hot water on a stove.

Cement for cracks in woodwork, &c.—Four parts of bees-wax to one of resin, melted together, and tinted with Indian red and yellow ochre.

Leather belts, &c., may be stained black with a solution of copperas.

Varnish for spurs—Boiled linseed oil and resin, warmed till the resin is dissolved.

Mast colour.—Dock-yard yellow, a little white, and warmed up with Venetian red.

Black Stain.—Into a breaker put 2 lbs. copperas, 2 lbs. nut-gall, 8 lbs. alum, pounded up; 8 lbs, old iron, and 25 pints of vinegar. When wanted boil as much as is required and lay on hot. It is better to make a large quantity at first as the longer it is kept the better it becomes. Three or four coats are necessary.

French Polish—5 oz. naptha, 1 oz. shellac, 10 grains of isinglass, 1 dram of myrrh, and 6 drams of olive oil.

Whitewash.—The best is made from quicklime, for it will not rub off, and if kept in a tank, there can be no danger from it. To keep whitewash in good order, all marks should be rubbed out and the whole smoothed down with hard canvas rubbers on sticks, before going over it at any time.

Scraping masts and booms.—Instead of going through the scraping process every Saturday, and covering your deck with chips, send the booms down on deck when they want it and scrub them with sand and canvas; both lowering them down, and swaying them across together. The dirt should merely be scraped off the top-gallant masts as an ordinary practice, and a light plane-over given to them at long intervals

after a general refit, which is infinitely less injurious to them, at any time, than scraping with knives.

Though the "watch mark" on the arm is usually a sufficient indication; "Which watch on deck?" is a question often asked when the hands are employed; therefore have a brass S or P hung upon the wheel, and turned at the end of every watch.

Washing-tubs.—The lower hoops should be knocked up an inch or two, when drawn, or your decks will be marked.

A large dirt-tub on the main deck, to collect the rubbish of all decks, whipped up at the end of each watch, and capsized with a slip-toggle, is far better than a head-shoot dangling from the bows.

Holystoning, *too frequently*, makes the deck rough. A sprinkle and scrub at seven bells in the forenoon, with hand-brushes, cloths, or hand-swabs, dries rapidly in warm weather, and render it less necessary.

Instead of lowering the duty cutters on alternate days, keep each at the davits for a week at a time. On Saturday, keep the boat up that has done duty for the week; clean, and paint her bottom, if it requires it: and you have then the ensuing week to touch her up and put her to rights ready for relieving the other cutter. With boom-boats the same; for, if they are worked indiscriminately, they can never be kept in proper order.

In a small vessel never be induced to advocate the relinquishment of mess-tables and stools. Men sprawling on the deck among their beef and pork has a dirty, demoralizing effect; which has only to be witnessed to convince one of.

Saturday being the great cleaning and renovating day, it is a good plan to muster the watch in the morning in their clean working rig, duck jumper and trousers, which though tarred and stained, may never-the-less be kept scrupulously clean.

Sunday, the blessed day of rest, is too frequently a day of bustling, fatiguing duties, and the most undesired of all the seven. From the hour of commencing work in the early morning, until the pipe to dinner at last releases you there is often no cessation. To those on whom the work of the ship devolves, Divine service is no relief, for it is then felt to be part of a relentless routine that has to be gone through, and they are only too glad when what, week after week, seems an interminable repetition, is brought to a close. I know of no remedy for this serious evil short of total change in the character of the day, as it is at present viewed. Instead of looking upon it as the first day of a new week, with your hands clear until the work of the week on the morrow commences, it is generally considered the winding up day of the previous week, when all its accumlated details have to be examined and gone into. On Sunday the paymaster makes up his books, and gives in his report ; warrant-officers' accounts and midshipmen's logs are written up and sent in ; defaulter's book and defaulters examined ; Articles of war read ; ship's company mustered by open list ; and the whole ship—decks, holds, and store-room, minutely and rigorously inspected, after a laborious preparation, which is then followed up by a lengthened service of prayer and homily.

Unless the above necessary duties are transferred to another day, Thursday for instance, I cannot see how the sacred nature of the Sabbath is to be maintained. Holyston-

ing decks and crossing upper yards, on Sunday morning, may now be counted as things of the past ; but to be consistent in this, the rigorous Sunday inspection, with it jading, temper breaking preludes and accompaniments, should be simplified as much as possible. By all means muster at divisions ; but leave the general inspection of the ship for a week-day. *A well-regulated ship should always be ready ;* but the usual Sunday spruceness, obtained at so great a sacrifice, is frequently on a great deception, and by it that which is know by the name of "Divine Service," is rendered a soulless and compulsory piece of acting. Under such circumstances, no one for a moment can imagine that men, who from their habits are totally unaccustomed to any but the briefest contemplation or connected thought on abstract subjects, can give their minds, for an hour and a half, to the devotions they are assembled to take a part in. Of course, such a startling improbability *is* not entertained by any one, and we are therefore driven to the conclusion that "Divine Service" is often only maintained for the mere sake of keeping up appearances, and to be in accordance with the "Articles of War."

I would beg of my young readers to treasure up, and abide by those few wise words, which, often quoted, are known as "the golden maxim" of the great Sir Matthew Hale :—

A Sunday well spent,
Brings a week of content,
And health for the toils of morrow
But a Sabbath profaned,
Whatsoe'er may be gained,
Is a certain forerunner of sorrow.

He made this his rule of life and hear what he says as it was drawing on to its close :—

"I have found by a strict and diligent observation, that a due observation of the duty of this day, hath ever joined to it a blessing upon the rest of my time ; and the week that hath been so begun, hath been blessed and prosperous to me : and on the other side, when I have been negligent of the duties of this day, the rest of the week hath been unsuccessful and unhappy to my own secular employment ; and this I do not write lightly inconsiderately, but upon a long and sound observation and experience."

Capital Punishment.—By the power of life and death vested in courts-martial, the duty of carrying out the extreme sentence of the law devolves upon the naval officer. Happily this is of so rare an occurrence, that few can be conversant with the unattractive detail of the duty ; and from motives of humanity I think it right to explain it. It is a repulsive subject, and I may perhaps be considered guilty of very questionable taste in discussing it ; but I don't object to that, should it happen at any time to tend to the furtherance of the service. The traditionary knot is made with a bight, as for a sheepshank, the end then wound round its own and all parts, passed through the upper bight, which is then hauled down, and a running noose formed. The whip is led through a block on the cap, down through one on the fore yard-arm ; the end sheepshanked with a hitch only round the lower bight, but the upper bight seized to the standing part with a slight twine stop. At six feet from the end, below the seizing, a toggle is seized, to cause the drop. The stop carries away on being brought up

against the block, the sheepshank falls adrift, and the toggle, with a jerk bringing up against the block, answers the purpose of "belay" to the men on the whip. The execution takes place when and where the commander-in-chief directs, but usually on board the ship in which the crime has been committed. The boats of the fleet form round; the whip is manned by two men from a boat of each ship (a lieutenant from each attending), taken from whatever thwart in the boat that the captain, surperintending the duty, thinks fit to direct. The criminal being pinioned, is removed from irons, and brought on deck under a guard; the sentence of the courts-martial, and article of war is read—the cap drawn down—the knot adjusted—the gun fired, and the sentence executed.*

* In Osler's "Life of Lord Exmouth," among the many instances of his stern energy of character, there is one related in connection with this subject, which I am led to extract, as much for the example it affords of mental intrepidity in the discharge of duty as for the opportunity it gives me of bringing that matchless biography to the notice of those who are strangers to the record of that great and good man's life.

"Considerate as he was upon all occasions when human life was concerned, and unwilling to resort to punishment, he was always anxious to make it as impressive as possible whenever it became necessary to inflict it. He assisted to try one of the mutineers of the 'Hermione,' whose crime was attended with circumstances of peculiar aggravation,—Captain Pigot having brought him up from a boy and treated him with much kindness and confidence. His crime was fully proved; and the court being cleared, Sir Edward proposed that sentence should be executed immediately. The circumstances of the case demanded, in his opinion, unusual severity, which might be expected to have good effect upon the fleet; while there was every reason to conclude, from the prisoner's demeanour before them, that

ORDER OF CONDUCTING FUNERALS ;—*Of a Lieutenant.*

Of the Ship.

Firing party.
Band.
Gun Carriage and Limbers,
(on which is placed the Coffin.)

Lieutenant. Lieutenant.

Lieutenant. Lieutenant.

{One other W. R. Officer.} {One other W. R. Officer.}

Surgeon and Captain (Chief Mourners.)
Boys—Midshipman in charge.
Seaman— ,, ,,
Petty Officers—Sub.-Lieutenant in charge.
Warrant Officers.
Gun-room Officers.
Ward room Officers.

Of the Squadron. Boats' Crews, attended by Boat Midshipmen.
Officers.

Going—Juniors first. Returning, Seniors.

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if delay were allowed, he would meet his fate with hardihood which would destroy the value of the example. The court at first questioned their power to execute without the warrant of the Admiralty, but this was quickly settled by reference to the Act of Parliament. The president then declared that he could not make the order. 'Look here!' said he, giving to Sir Edward his hand, trembling violently, and bathed in a cold perspiration. 'I see it and I respect your feelings,' replied Sir Edward, 'but I am sure that such an example is wanted, and I must press the point.' 'Well,' he replied, 'if it be the *unanimous* opinion of the court, it shall be done.' It was agreed to, and the prisoner was called. Though sure that he must be con-

Firing Party;—The King's Regulations lay down, that the strength and composition of the firing party is to be regulated by the Senior Officer present, according to the relative rank of the deceased, and the means at disposal. The Rifle and Field Exercise book lays down, that for Petty officers and seamen, the Firing Party is to consist of one bugler, 26 men, and one Petty officer in command.

Gun Carriage and Limbers.—With a 9 pr. gun it is usual to leave the gun mounted, and to build a small platform over it and the limbers, on which to rest the coffin. The number of men on the drag-ropes can with advantage be increased beyond the usual number of a Field gun's crew, by prolonging the ordinary drag-ropes with another pair.

530. DRESSING SHIP.—The arrangement of flags adopted in the Service is the same for all ships and is laid down by the Signal regulations.

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demmed, he entered with a bold front; but when he was informed that he would be executed in one hour, he rolled on the deck in an agony. 'What! gentlemen,' he exclaimed, 'hang me directly! will you not allow me a few days—a little time—to make my peace with God?' The whole fleet was appalled when the close of the court-martial was announced to them by the signal for execution; and at the end of the allotted hour, the wretched criminal was brought up to undergo his sentence.

"The clamour of that false humanity which is one of the most prominent vices of the present day would never influence him. Little consideration can be claimed for that pretended sense of honour which is sensitive to the degradation of punishment, but callous to that of crime."

In all cases the Union Jacks are on each side of the main, unless dressing ship with a Foreign ensign at the main, when the Union Jacks are to be omitted.

Top-gallant yards are generally not sent down on the evening previous to dressing ship; but, should they be, cross them in the morning at seven bells. The flying jib and royal halyards are used to trice up by, rove through blocks at the mast-heads, with down-hauls attached; and the flags, in addition to being stopped at the head and tack, are stitched to the halyards amidships. Reeve them before breakfast, and bend the flags on; and at two minutes before eight trice up mast-head ensigns, made up, and send aloft the captain of each top and two hands, one of whom, going to the mast-head, stops the tack in when broke; the other, remaining in the top, clears the flags, should they foul.

On a shift of wind, or at the turn of the tide if lying in a tideway, send hands aloft together to clear the flags.

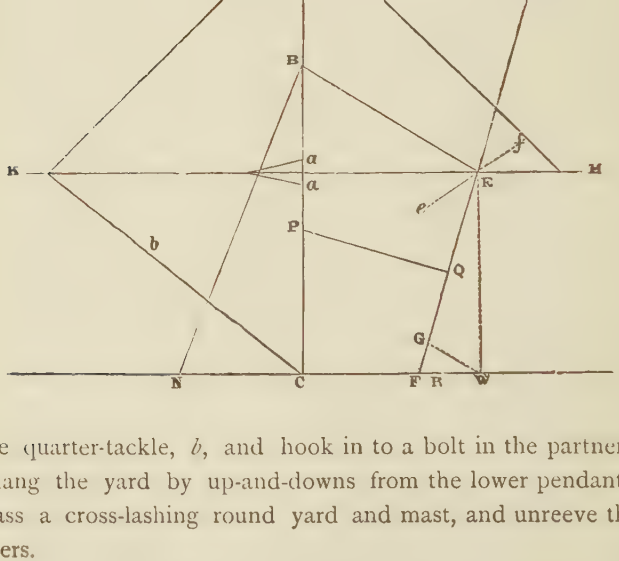
531. His Majesty's Birthday.—Dress ship at 8 A.M. Noon, fire the first gun of a royal salute. The salute over, the band plays the national anthem, all present standing with heads uncovered.

When the ship is illuminated in the evening, lanterns are placed in all the ports, and hung at the yard-arms, mast-heads, &c.

Anchoring in a Foreign Port.—After the salute to the flag, of twenty-one guns, the admiral of the port is saluted, and if you think fit, the governor also; but, at the salute to the admiral, the jib is run up or fore topsail

loosed, hoisted, or let fall at the first gun ; and hauled down or picked up when over. This indicates a salute to some one afloat, but it is not always observed.

532. Hoisting in Heavy Weights.—A 30-ton gun. Lower the main yard to a distance of forty feet from the deck, clap a couple of stout anchor-strops on the lee quarter, cleat them up, and pass trustworthy lashings, *a*, *a*, through the bights of the strop and round the mast ; overhaul the



lee quarter-tackle, *b*, and hook in to a bolt in the partners. Hang the yard by up-and-downs from the lower pendants, pass a cross-lashing round yard and mast, and unreeve the jeers.

Derrick.—Get the spare main top-mast up, droop it to the proper angle, wedge the heel up and secure it, shore

the decks up, and lash the derrick with a cross-lashing to the after side of the main yard,—the lashing passed in the direction *e f*.

Topping lift.—Fish-fall, rove from the opposite side of the deck, through the fish-davit head block at the mast-head.

Derrick head guys.—Main runners and tackles—forward and aft; runners hitched round derrick head and yard.

Shore, P. Q.—Mizen gaff. The jaws lashed upon the derrick, and the peak to the mast with a cross-lashing and turns through the peak-halyard bolts.

Belly guys.—Forward and aft. Up-and-down tackles with luffs on their falls; two to be hooked forward, the outside one to be dipped outside the derrick purchase as the stay purchase is hauled on, and the midship one come up when the other is taut.

Derrick-head purchase.—Block, treble and fourfold 30-inch purchase blocks. Fall, 9-inch hawser.

Mast-head purchase.—Reeve two top-tackle pendants through the top-blocks, pass the ends up through the hole for the slings on the fore part of the top, and secure them round the eyes of the rigging. Haul the top blocks out to the derrick-head by a fish-fall, rove full; the hauling part being led through a block at the mast-head. Reeve a cat-fall through two cat-blocks for the purchase, trice it up and hook it to the pendants.

The main yard is used to prevent the derrick coming in when the stay purchase is hauled upon; and it also acts as a cross-piece to the topmast, to prevent the purchase slipping

down. It consequently hangs freely, being supported at the yard-arm by the topping-lift; and the trifling strain brought upon it, being horizontal, is thrown upon the quarter and cross-lashings round the mainmast.

To ascertain the strain the gear will have to bear, lay off B C equal to the length of the mast from deck to trestle-trees, minus the drop of the topping-lift block, which will be about 63 feet. Project the main yard, K H, at the calculated height from the deck, = 40 feet. Raise the derrick, F M, at the necessary angle, and position upon the deck, N R. Connect E B N, to represent the topping lift; and let fall E W, to represent the purchase with the weight attached.

On the line E W lay off E W = 40 tons (weight + resistance in lifting, or 30 + one third), and draw W G parallel to B E. Then G E will represent the pressure on the derrick in the direction of its length, and G W the tension on the topping-lift E B. Measure G E and G W; and it will be found that the derrick will have to support a strain of 35 tons, and the topping-lift a strain of 12 tons.

To find, now, what the purchases, topping-lift, and derrick are capable of bearing :—

Derrick-head purchase.—Seven parts of 9-inch hawser, minus the allawonce for friction, by rule previously given (Art. 31), are capable of *lifting* 73·5 tons.

Mast-head purchase.—Two pendants of 9-inch rope = 39 tons. Fall, six parts of 6-inch rope = 39 tons.

Topping-lift.—Five parts of 5-inch = 23 tons.

To ascertain the strength of the derrick.—

Least diameter of topmast, 20 inches	...	1·301030
		4
		5·204120
121		9·082785
		4·286905
Tab. No. Norway spars, 5830000		6·765669
		1·052574
E Q, 21 ft. = 252 in. Squared	...	4·802802
	lbs.	6·249772
112 lbs. in cwt. ...	...	2·049218
	cwt.	4.200554
20 cwt. in ton ...	...	1·301030
4)793 ...	tons	2·899524

198 tons = practical strength of derrick.

The whole length of the derrick, E G, is 42 feet; but, as it is securely held amidships by the shore and belly-guys, the distance between the supports is that alone affected by the strain. Without the shore and belly-guys, the derrick, by calculation, would only support a weight of 50 tons. And, as strength varies inversely with the square of the length, $21^2 : 42^2 :: x\ 198$. By this, also, $x = 50$ tons nearly.

Thrown into a tabular form it will be seen that there are means for lifting any possible weight with ease and safety.

To bring the gun in over the main hatchway, rig a stay derrick of the spare fore topmast, and support it by a topping-lift, belly-guys, and a shore to the mainmast.

Gear.	Capacity for strain; calculated at the minimum strength of materials.	Strain produced.
Derrick-head purchase...	Fall ... ... 73 tons (Blocks ... 84 ,,)	40 tons
Mast-head purchase ...	39 ,,	
Topping-lift	23 ,,	12 ,,
Derrick	198 ,,	36 ,,

Purchase.—Blocks, upper fore and main jeer-blocks. 26-inch and 24-inch treble. Fall, fore and main jeers, 8 inch add $7\frac{1}{2}$-inch spliced together.

Topping-lift.—A cat-fall, rove through top-tackle blocks.

Mast-head purchase used for hoisting up, is eased in, and becomes a stay purchase.

Explanation of Table III.—"The first column of figures, marked C, contains the mean strength of cohesion on an inch section of the material; the second, marked S, the constant for transverse strains; the third, marked E, the constant for deflections; and the fourth, marked M, the modulus elasticity.

"1. *To find the absolute strength or force of direct cohesion of beams or rods of given materials*, that is, their absolute resistance to longitudinal tension or strain in lbs. Rule.—*Multiply the area of the transverse section of the rod or beam in inches by the tabular number, in the column marked* C, *opposite the name of the material, and the product will be the strength or resistance required. Note* 1.—In practice the weight or strain should not exceed $\frac{1}{3}$ of the absolute strength according to Barlow, or $\frac{1}{4}$ according to Tredgold. Thus, the force which would tear asunder a piece of teak $4\frac{1}{2}$ inches broad and 2 inches thick, is $2 \times 4\frac{1}{2} \times 15000 = 135000$ lbs. Hence a

longitudinal strain of more than 45000 lbs. would be unsafe in practice. *Note* 2.—The tenacity of materials of the same kind is proportional to their specific gravity. Hence, a piece of teak whose specific gravity was $\frac{1}{20}$ part less than that of the preceding, would have $\frac{1}{20}$ part less of cohesive power.

"2.—When the direction of the straining force does not coincide with the perpendicular to the centre of tenacity or centre of gravity of the transverse section, the Rule is modified as follows : Multiply the tabular number in column C by the breadth and the square of the thickness of the beam, both in inches, and divide the product by the sum of the thickness and 6 times the distance of the line of direction from the centre of the section, in inches ; the quotient will be the absolute strength required, of which take $\frac{1}{3}$ as before, for the practical load. *Note.*—In actual construction an allowance of $\frac{1}{3}$ of the thickness should be made for the probable deviation of the direction of the stretching force. The absolute strength will then be $\frac{1}{3}$ of that found by the Rule in the preceding article ; and the practical load $\frac{1}{9}$ of the same quantity, or $\frac{1}{12}$ according to Tredgold.

"3. *To find the dimensions of a rod or beam to resist a given longitudinal strain,* that is, to sustain a given weight without fracture in the direction of its fibres. *Rule.—Multiply the tabular number in column C, by the number denoting the ratio of the breadth to the thickness, and divide* 9 *(or* 12*) times the given weight in lbs. by the product ; the square root of the quotient will be the required thickness in inches and the thickness multiplied by the number of the ratio will give the breadth required.* Thus, the dimensions of a beam of the strongest English oak to sustain a load of 20 tons in the direction of its fibres, supposing the breadth to be 3 times its thickness is $\sqrt{\ }\ (9 \times 44800) \div (3 \times 15000)\ \} = 3$ inches nearly, the thickness required ; whence $3 \times 3 = 9$ inches, the breadth required. *Note.*—If the beam be cylindrical, divide 9 times the given weight by ·7854 times the tabular number, and the square root of the quotient will be the diameter.

"4. *Force of the Transverse Resistance of Materials.*—This force is proportional to the product of the breadth and the square of the depth in rectangular beams (more properly parallelopipedal beams), and to the cube of the diameter in cylindric beams; but it is in the inverse ratio of the length, modified by the cosine or square of the sectant of the angle of deflection immediately before fracture, and by the manner in which the beam is supported. In ordinary practice, the consideration of the angle of deflection may be omitted.

"5. *To find the relative strength or force of resistance of rectangular beams or rods of given materials, to transverse strain or pressure in lbs.* 1. When the beam is *fixed* at one end and *loaded at the other. Rule*—Multiply the tabular number, in the column marked S, opposite the name of the given material, by the breadth of the beam in inches, and this product by the square of its depth in inches, and divide the result by the length of the beam in inches, the quotient will be the strength or resistance required. 2. When the beam is *fixed* at the one end and *uniformly loaded*, the strength or resistance will be *double* the preceding resistance, which for brevity we shall call the *prime* resistance. 3. When the beam is *supported* at both ends and *loaded in the middle*, the strength will be *four times* the prime resistance. 4. When the beam is *supported* at both ends and *uniformly loaded*, the strength will be *eight times* the prime resistance. 5. When the beam is *fixed* at both ends and *loaded in the middle*, the strength is *six times* the prime resistance. 6. When the beam is *fixed* at both ends, *and uniformly loaded*, the strength is *twelve times* the prime resistance. 7. When the beam is *supported* at both ends, and *loaded at a point not in the middle*, the strength is found by multiplying the prime resistance by the square of the length, and dividing the result by the product of the lengths of the segments into which the beam is divided at the point of application of the load.

"6. In all the preceding cases, it must be remembered that not more than *one-third* of the ultimate strength found by the rule, ought to be depended upon for any permanent construction, accord-

ing to Barlow, and only *one-fourth* according to Tredgold, who adds that if the beam be not horizontal, the distance between the supports must be the horizontal distance. As an example, the weight which a beam of Riga fir, 20 ft. long, 12 inches broad, and 12 inches deep, supported at both ends, would sustain in the middle, is $(1130 \times 12 \times 144) \times 4 \div 240 = 32544$ lbs and the practical load is $32544 \div 3 = 10848$lbs. or $32544 \div 4 = 8136$ lbs.

"7. When beams are cylindrical, their resistance to transverse pressure is only two-thirds of that of square prism of the same thickness. In the case of hollow cylinder, the resistance will be found by multiplying the difference of the cubes of the interior and exterior diameter, by 8 times the modulus of elasticity and dividing the product by 9 times the length. If the hollow part be $\frac{9}{10}$ of the diameter of the cylinder, its strength, will be reduced to about $\frac{1}{12}$ more than a $\frac{1}{4}$ of that of a solid cylinder; but if the tube were formed into a solid rod, its strength would be only $\frac{1}{12}$ part of that of the solid cylinder. A cylinder having half its core hollowed out should be rendered only $\frac{1}{8}$ part weaker, which agrees with an experiment made by Barlow. We see here the divine process of nature in making the bones of animals hollow, and the imitative ingenuity of man in making cast-metal pillars tubular, thus combining lightness with strength in their structures.

"8. The *lateral* or transverse strength of any beam thus depends mainly on the distance and cohesion of the upper and under surfaces. Whatever stiffens the exterior layers contributes greatly to strengthen the whole. A small incision drawn across the under side weakens a bar essentially; while a notch cut near the middle of the upper side will not impair the strength, but if not filled up with a harder material will even sensibly augment it. Thus Duhamel found that a bar of willow cut through $\frac{1}{3}$ of its depth, the cut being filled up with a thin slip of hard wood, was thereby rendered $\frac{1}{6}$ part stronger than before. It was even then remarked that the incision could be carried much farther without injuring the strength of the bar.*

*Leslie's Natural Philosophy, p. 271.

"9. *To find breadth and depth of a beam of given length and material, so that it may, in practice, support a given load,* in the case of prime resistance (art. 5) *Rule*—Multiply the given weight in lbs. by the length in inches, and divide this product by 4 times the product of the tabular number in col. S, and the number denoting the ratio of the breadth to the depth ; then, the cube root of the quotient will be the required depth in inches, from which the breath is found as before (art. 3.) In all other cases, the tabular number in col. S must be multiplied by the number denoting the increase of strength or resistance arising from the mode of fixing the beam (art. 5), before the above rule be applied. Thus, the depth of a beam of Scotch fir, 18 feet long, to bear a load of 20 tons at the middle, when supported at both ends, the breadth being half of the depth is $\sqrt[3]{\{4 \times 44800 \times 216) \div (1140 \times \frac{1}{2} \times 4)\}} = 20{\cdot}4$ inches nearly ; whence the breadth is 10 2 inches. When the breadth or depth is given, the calculation is easy, as the rule in art. 5 requires only to be reversed.

"10. *Deflection of Beams under Transverse Strains.*—The deflection of beams under given weights is proportional to the product of the weight and cube of the length directly, and to the product of the breadth and the cube of the depth inversely : whence the elasticity is deduced, being proportional to the deflection. Consequently, beams will be of the same stiffness, when the depth is increased in the same proportion as the length, the breadth remaining the same ; and the deflection of beams arising from their own weight, having their several dimensions proportional, will be as the square of either of their like lineal dimensions. The same will apply to beams loaded throughout proportionally to the dimensions : this ought to be kept constantly in view in the construction of models, on a small scale, of works intended to be executed on a large one.

"11. *To find the Deflection of a Beam* ; 1. *When supported at both ends and loaded in the middle.* For brevity's sake we shall call this the *prime* deflection. *Rule multiply the given weight in lbs. by the cube of the length of the beam in inches, and divide this product by the continous product of the tabular number, in the column marked* E, *opposite the name of the given material, the breadth, and the cube of the*

depth, the quotient will be the required deflection in inches. 2. When the beam is fixed at one end and loaded at the other, multiply the prime deflection by 32. 3. When it is fixed the same, but uniformly loaded, multiply the prime deflection by 12. 4. When it is supported at both ends and uniformly loaded, take $\frac{3}{8}$ of the prime deflection. 5. When it is fixed at both ends and loaded in the middle, take $\frac{2}{3}$ of the prime deflection. 6. When it is fixed the same, but uniformly loaded take $\frac{5}{192}$ of the prime deflection. Thus, the prime deflection of a beam of pitch pine, 30 feet long, 6 inches broad, and 10 inches deep, supported at both ends, and loaded in the middle with a weight of 1000 lbs. is $(1000 \times 27000 \times 1728) \div (5000000 \times 6 \times 1000) = 1\frac{5}{9}$ inches nearly; whence the deflection due to other modes of fixing and supporting, may easily be found. *Note.*—If the beam be a cylinder, the deflection will be 1·7 times that of a square beam in similar circumstances.

"12. *To find the weight which will produce a given prime deflection on a beam of given material and dimensions. Rule.*—Find the continuous product of the tabular number in col. E, the breadth, the cube of the depth, and the given deflection, and divide this product by the cube of the length; the quotient will be the weight required. Thus, the weight which will produce a deflection of $1\frac{1}{2}$ inch on a wrought iron beam, 20 feet long, 3 inches broad, and 9 inches deep, supported at both ends, and loaded in the middle, is $(91440000 \times 3 \times 729 \times 1\frac{1}{2}) \div (8000 \times 1728) = 21699$ lbs. or near 10 tons; whence, the weight for other deflections may easily be found.

"13. *To find the depth requisite for a beam of given material, length and breadth, to bear a given load with a given prime deflection. Rule* - Divide the given loads in lbs. by the continous product of the tabular number in col. E, the breadth and deflection, and multiply the cube root of the quotient by the length; the product is the depth required. Thus the depth of wrought-iron beam, 20 feet long, 3 inches broad, requisite to support a load of 10 tons with a prime deflection of $1\frac{1}{2}$ inch, is $240 \times \sqrt[3]{\{10 \times 2240) \div 91440000 \times 3 \times 1\frac{1}{2})} = 9{\cdot}1$ inches nearly. When the breadth is not given, multiply the given weight by the cube of the length, and divide this product by the product of the tabular number in col. E, and the given deflection, the quotient is

the product of the breadth and cube of the depth. Hence, when the beam is to be square, the fourth root of the quotient is the breadth or depth required: and when it is to be cylindric, multiply the quotient by 1·1, and the fourth root of the product will be the diameter.

"14. *The modulus of elasticity* is the measure of the elastic force of any material. It is found by the following proportion: As the portion of a length of a column of the material, which it loses by compression, is to the whole length before compression; so is the force which produced that compression to the modulus of elasticity. Sir John Leslie has shown that the modulus of elasticity is found by dividing 5 times the fourth power of the length of a beam by 32 times the product of its spontaneous depression and the square of its depth. In his work on *Heat*, he observes that a white deal 138 inches long and $\frac{2}{10}$ of an inch deep, suffered a depression of $2\frac{1}{2}$ inches by its own weight; hence $(5 \times 138 \times 138 \times 138 \times 138) \div (32 \times \cdot45 \times \cdot45 \times 2\cdot5 =$ 111936000 inches or 9328000 feet, in round numbers. The numbers in col. M may be found from those in col. E, by multiplying the latter by 576, and dividing the product by the corresponding specific gravity.

"15. *The resistance of Materials to a crushing force*, appears to be directly proportional to the fourth power of the diameter in cylinders, or of the side in square prisms, and inversely proportional to the square of the height.

"16. *To find the weight which a column of given material will support before flexure.*—Multiply the tabular number in col. E by 121 times the fourth power of the diameter in inches in cylindric columns, or ·2056 times the side in inches, in square prismatic columns, and divide the product by the square of the length in inches the quotient is the weight required in lbs. *Note.*—When the base of the column is rectangular, multiply the tabular number by ·2056 times the area multiplied by the square of its breadth, and divide as before. Only $\frac{1}{3}$ or $\frac{1}{4}$ of this weight ought to be depended upon in practice; for when once the column begins to bend, the consequences are inevitable. Thus, the weight under which a pillar of New

England fir would begin to bend, supposing its length 20 feet, and its diameter 12 inches, is $(596700 \times \cdot121 \times 12 \times 12 \times 12 \times 12) \div (20 \times 20 \times 12 \times 12) = 259922 \cdot 52$ lbs., or nearly 116 tons, a most enormous load according to theory ; but 29 tons could only be trusted in practice.

"*The Resistance of Materials to the force of Torsion, or Twisting*, is directly proportional to the angle of torsion and the fourth power of the diameter in cylindric shafts, and inversely as their length, according to Sir John Leslie: other writers say, that it is directly proportional to the cubes of the diameters. According to the Professor's law, the power of a iron cylinder to resist the torsion of a weight in lbs. acting at a distance of a foot, is found by dividing 600 times the fourth power of the diameter by the length. The preceding principle is employed in the construction of the *Balance of Torsion*, invented by Coulomb."

533. Foreign Measure.—As six metres are equal to $19\frac{1}{2}$ feet, there is just enough water for you ; and, at high water, as "the rise and fall is about a metre," there would be upwards of three feet to spare.

In the new French charts, the soundings are in *metres* ; but in their old charts in *brasses*.

534. Ascertaining Local Deviation of the Compass. —Lay a kedge out, and swing the ship with *her head* to each point of the compass, observing, as each point comes on, the bearing of some object whose distance—not less than six or eight miles—is such than its angular distance, between the limits of the ship's position while swinging, will not be perceptable. Note down these bearings, then land with a compass, and ascertain the bearing of the object on shore, when the ship and the distant object are in one. The difference between that and the various bearings taken on board, will give the local deviation for each point of the

compass;—east, when the ship's bearings are to the left of the true magnetic bearings; and west, when the contrary is the case.

Example.—Oct. 1, 1856. Second Bar Pagoda, distant 13 miles, bore from H.M.S.——, at anchor off Chuempee, N. 32° 20′ W. with the ship's head south; and N. 23° 5′ W. with her head N.W. From Anunghoy, with the ship and object in one, the Pagoda bore N. 29° W. Consequently the deviation of the south point of the compass was 3° 20′ E.; and of the N.W. point, 5° 55′ W.

In a close harbour, where there is no object sufficiently remote for the purpose, it will be necessary to erect a mark on shore, and to land an assistant with a compass to take reciprocal bearing. When ready, you hoist a preconcerted signal, which you dip as the ship is swung on each point of the compass to the mark ashore. The difference between the bearing of the mark from the ship, and the bearing of the ship from the mark, reversed, is the deviation of the compass on board, corresponding to the direction of the ship's head at the time of each observation. If there is any actual difference between the compasses employed, the correction must be made. To ascertain it, land the compasses, and compare the bearings of an object taken with each; but the compasses should not be within twelve feet of each other.

When unable to land, take the bearings of a distant object with the ship's head round the compass. Assume the true magnetic bearing to be the mean of these; and by comparison ascertain the deviation on each point accordingly.

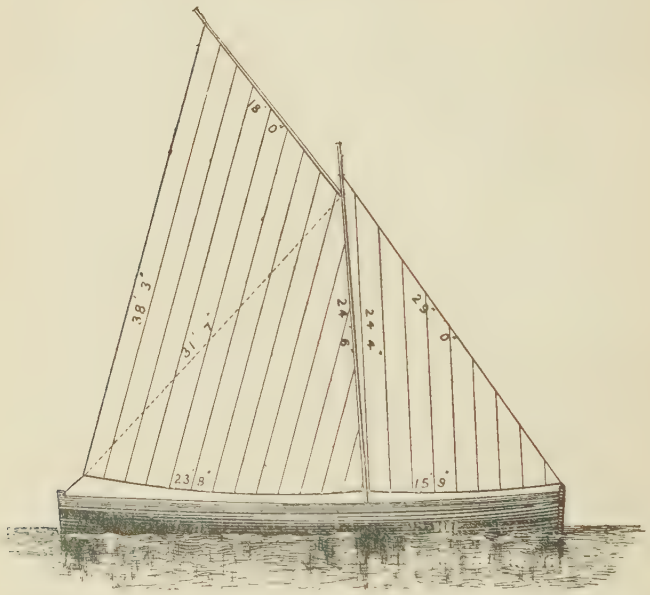
As the deviation in the northern hemisphere is changed in the southern hemisphere, it will be frequently necessary at sea, if the deviation is great, to determine it afresh as you alter your latitude. You should, therefore, take advantage of light winds, or calm weather, to ascertain the variation of the compass by azimuth observations, with the ship's head in different directions, computing the deviation on the points you have not observed, from those that have been ; the rule for which will be found in Inman, art. 308.

535. Positions and Dimensions of Masts and Yards. —The reader is referred to Finchman's "Treatise on Masting Ships," for a complete investigation of the subject in all its bearings.

"The common rule for determining the masts and yards by the length and breadth of the vessel, has been admitted by long use, and may be considered equally good with any of the rules at present given as approximations ; for the yards must be governed by the length, in order that the sails may have a suitable spread ; and the breadth, which determines the length of the masts, that they may have proper support by the spread of the rigging, has the greatest influence on the stability."

536. SERVICE RIG OF BOATS.—

FORTY-TWO FEET LAUNCH.



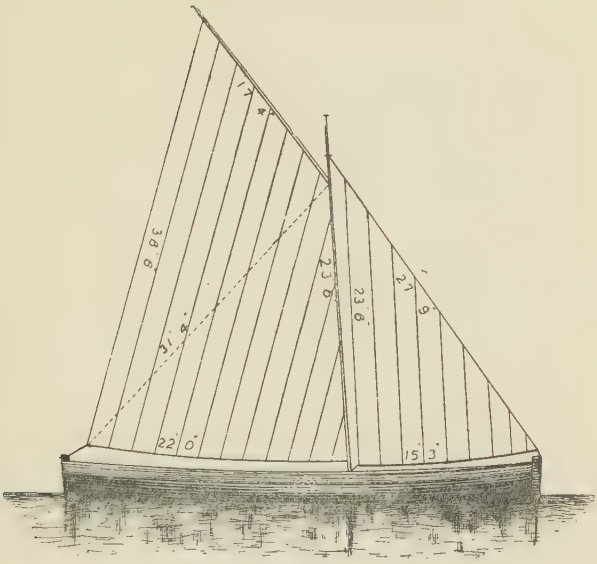
DIMENSIONS OF SPARS.

	ft.	in.
Length of Mast from top of wash strake to hounds ...	27	7
Length of Head	4	0
Diameter of Mast		7
Length of Gaff	19	0
Diameter of Gaff		4½

AREA OF SAILS.

Stay Foresail ... 193 square feet. Gaff Mainsail 522 square feet.

FORTY-FEET LAUNCH.



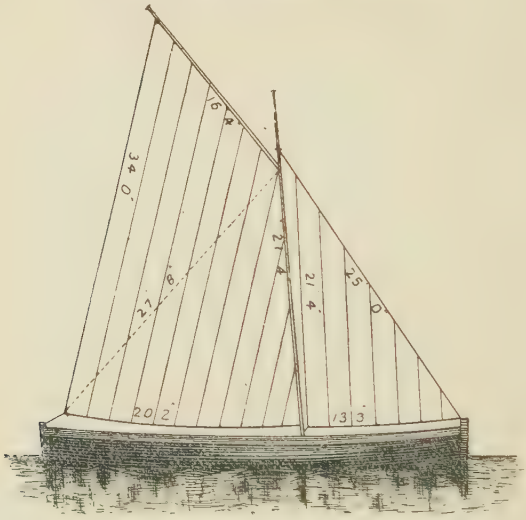
Dimensions of Spars.

	ft.	in.
Length of Mast from top of wash strake to hounds ...	26	6
Length of Head	4	0
Diameter of Mast		7
Length of Gaff	18	6
Diameter of Gaff		4

Area of Sails.

Stay Foresail—170 square feet. Gaff Mainsail.—512 square feet.

THIRTY-SIX FEET PINNACE.



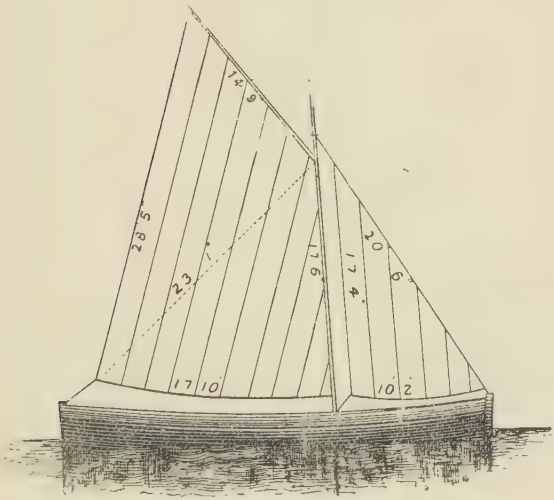
Dimensions of Spars.

	ft.	in.
Length of Mast from top of wash strake to hounds ...	24	6
Length of Head	3	9
Diameter of Mast		6
Length of Gaff	17	6
Diameter of Gaff		3½

Area of Sails.

Stay Foresail—134·75 square feet. Gaff Mainsail—428·5 square feet.

THIRTY-TWO FEET PINNACE.



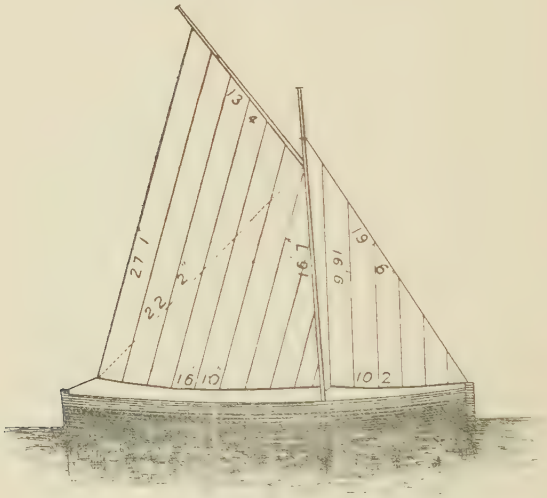
Dimensions of Spars.

	ft.	in.
Length of Mast from top of wash strake to hounds ..	20	6
Length of Head	3	9
Diameter of Mast		6
Length of Gaff	15	9
Diameter of Gaff		$3\frac{1}{2}$

Area of Sails.

Stay Foresail—87·2 square feet. Gaff Mainsail—316·5 square feet.

THIRTY FEET PINNACE.



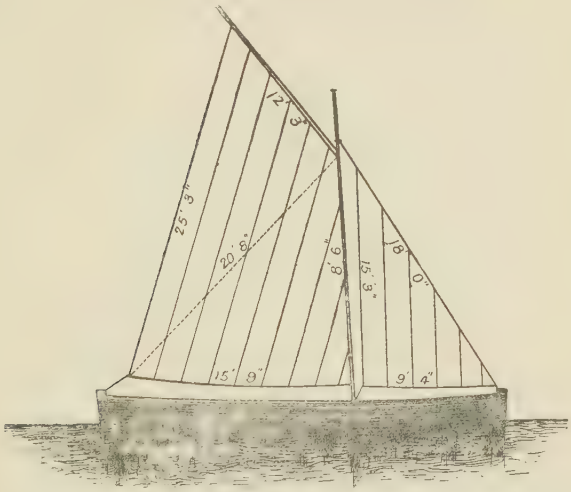
Dimensions of Spars.

	ft.	in.
Length of Mast from top of wash strake to hounds ...	19	6
Length of Head	3	9
Diameter of Mast		5¾
Length of Gaff	14	6
Diameter of Gaff		3¼

Area of Sails.

Stay Foresail—87·75 square feet. Gaff Mainsail—284 square feet.

TWENTY-EIGHT FEET PINNACE.



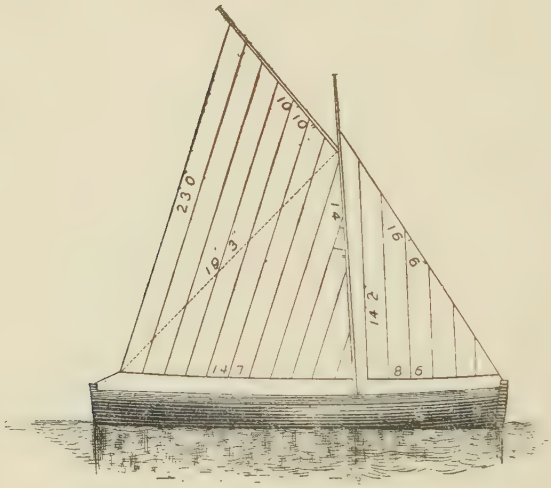
Dimensions of Spars.

	ft.	in.
Length of Mast from top of wash strake to hounds ...	18	4
Length of Head	3	6
Diameter of Mast		$5\frac{5}{8}$
Length of Gaff	13	3
Diameter of Gaff		3

Area of Sails.

Stay Foresail—72·5 square feet. Gaff Mainsail—245 square feet.

TWENTY-SIX FEET PINNACE.



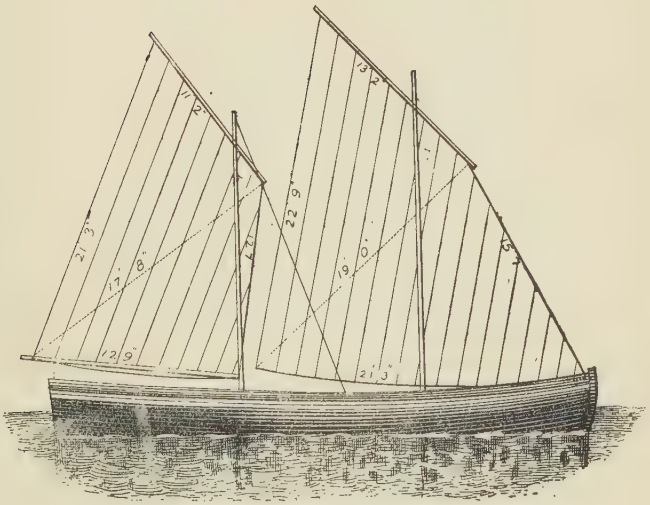
Dimensions of Spars.

	ft.	in.
Length of Mast from top of wash strake to hounds ...	17	0
Length of Head	3	3
Diameter of Mast		5
Length of Gaff	12	0
Diameter of Gaff		$2\frac{3}{4}$

Area of Sails.

Stay Foresail—58·75 square feet. Gaff Mainsail—202 square feet.

THIRTY-FOUR FEET CUTTER

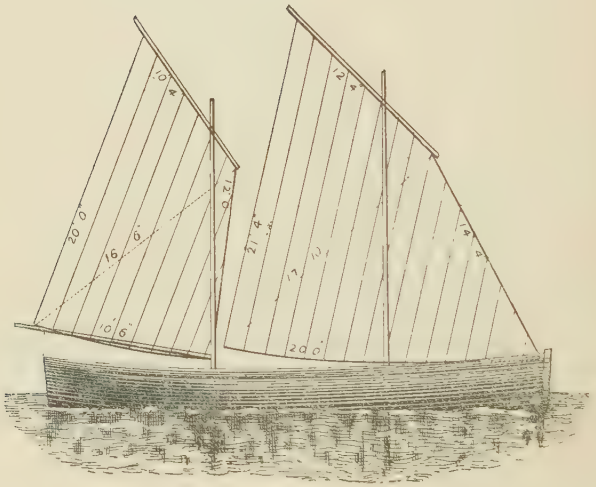


AREA OF SAILS.

Foresail—264 square feet.

Mainsail—177 square feet

THIRTY-TWO FEET CUTTER.



Area of Sails.

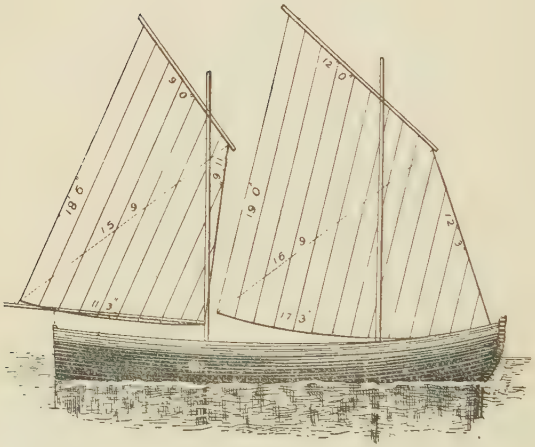
Foresail—235·5 square feet. Mainsail—146 square feet.

THIRTY FEET CUTTER.

AREA OF SAILS.

Foresail—212·5 square feet. Mainsail—149 square feet

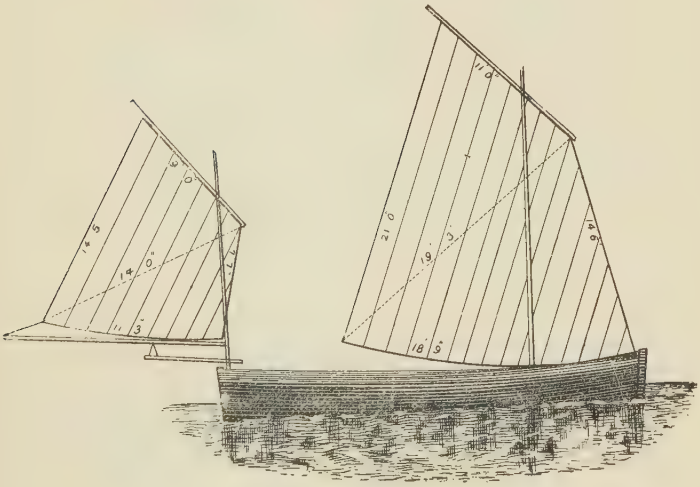
TWENTY-EIGHT FEET CUTTER.



AREA OF SAILS.

Foresail—194 square feet. Mainsail—138 square feet,

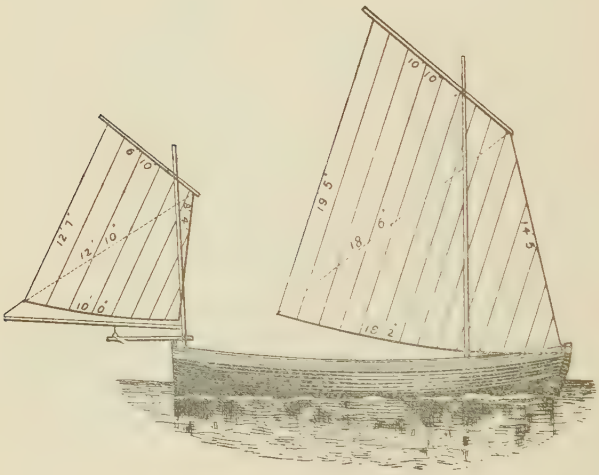
TWENTY-SEVEN FEET CUTTER.



Area of Sails.

Foresail—232 square feet. Mizen—103 square feet.

TWENTY-FIVE, AND TWENTY-SIX FEET CUTTER.



AREA OF SAILS

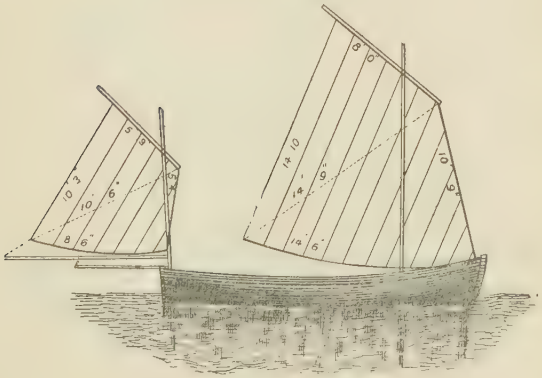
Foresail – 219 square feet. Mizen—83 square feet.

TWENTY-THREE FEET CUTTER.

AREA OF SAILS.

Foresail...190 square feet. Mizen—75 square feet.

TWENTY FEET CUTTER.



AREA OF SAILS.

Stay Foresail—128 square feet. Mizen—50 square feet.

EIGHTEEN FEET CUTTER.

AREA OF SAILS.

Foresail—23 square feet. Spritsail—93 square feet.

SIXTEEN FEET CUTTER.

AREA OF SAILS

Stay Foresail—22 square feet Spritsail—79 square feet.

THIRTY-TWO FEET GALLEY OR GIG.

AREA OF SAILS.

Foresail--95 square feet Mainsail—146 square feet.

THIRTY FEET GIG.

AREA OF SAILS.

Foresail—91·75 square feet. Mainsail—133 square feet.

TWENTY-EIGHT FEET GIG.

AREA OF SAILS.

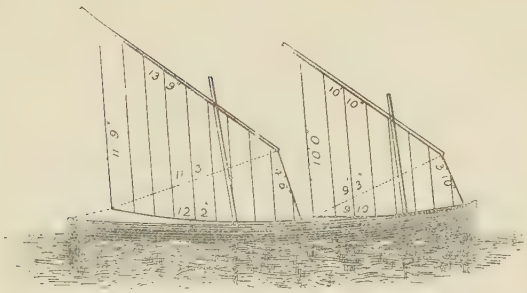
Foresail—74 square feet. Mainsail—109 square feet.

TWENTY-SEVEN FEET WHALE GIG.

AREA OF SAILS

Foresail—67 square feet. Mainsail—97 square feet.

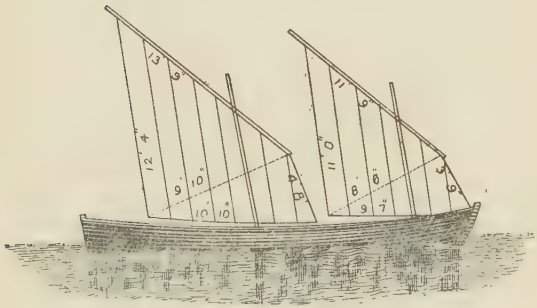
TWENTY-SIX FEET GIG.



AREA OF SAILS.

Foresail—62 square feet. Mainsail—90 square feet.

TWENTY-FIVE FEET GIG.



AREA OF SAILS.

Foresail—56 square feet. Mainsail—80·5 square feet.

TWENTY-FOUR FEET GIG.

Area of Sails.

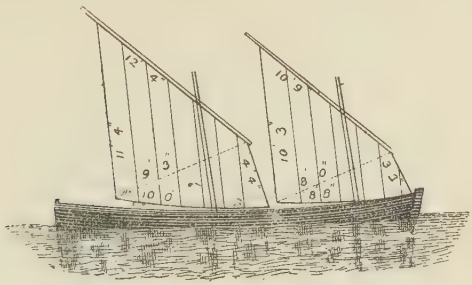
Foresail—58·5 square feet. Mainsail—74 square feet.

TWENTY-THREE FEET CUTTER GIG.

Area of Sails.

Foresail—50 square feet. Mainsail—69 square feet.

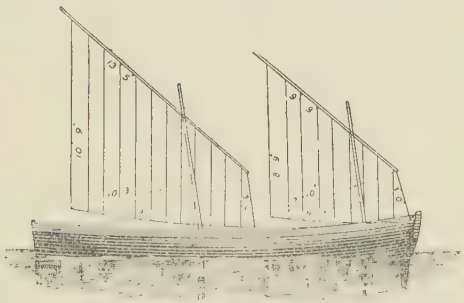
TWENTY-THREE FEET WHALE GIG.



AREA OF SAILS.

Foresail—51 square feet. Mainsail—70 square feet.

TWENTY TWO FEET GIG.



AREA OF SAILS.

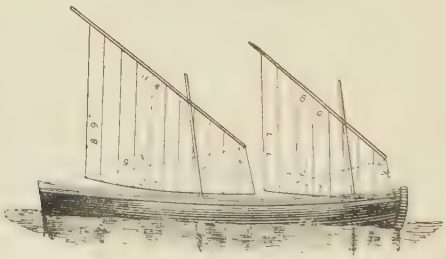
Foresail—43 square feet. Mainsail—69 square feet.

TWENTY FEET CUTTER GIG.

AREA OF SAILS.

Foresail—33 square feet. Mainsail—50 square feet.

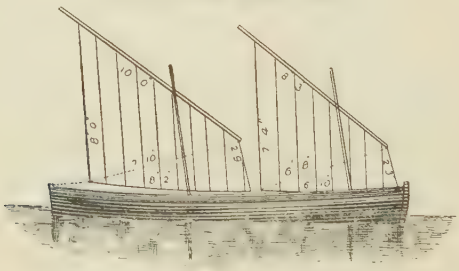
TWENTY FEET GIG.



AREA OF SAILS.

Foresail—35 square feet. Mainsail—51 square feet.

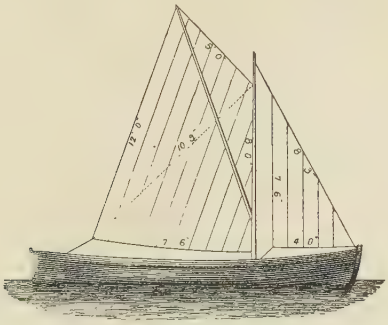
EIGHTEEN FEET GIG.



AREA OF SAILS.

Foresail—30·25 square feet. Mainsail—41 square feet.

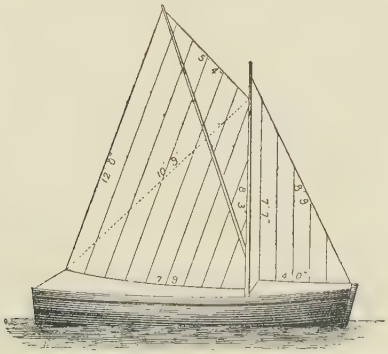
SIXTEEN FEET SKIFF DINGEY.



AREA OF SAILS.

Stay Foresail—15 square feet. Spritsail—63 square feet.

FOURTEEN FEET DINGEY.



AREA OF SAILS

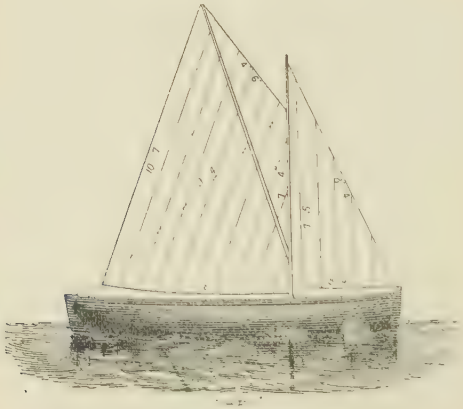
Stay Foresail—18·5 square feet. Spritsail—60 square feet.

THIRTEEN AND A HALF FEET DINGEY.

AREA OF SAILS.

Stay Foresail—14·5 square feet. Spritsail—54·5 square feet.

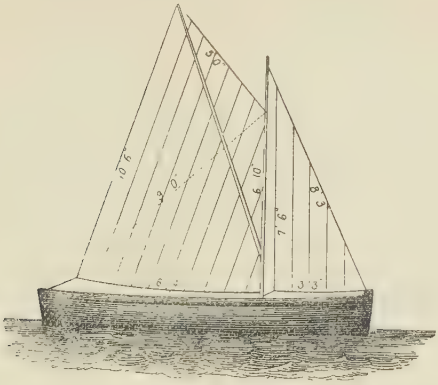
TWELVE FEET DINGEY.



AREA OF SAILS.

Stay Foresail—13 square feet. Spritsail—44 square feet.

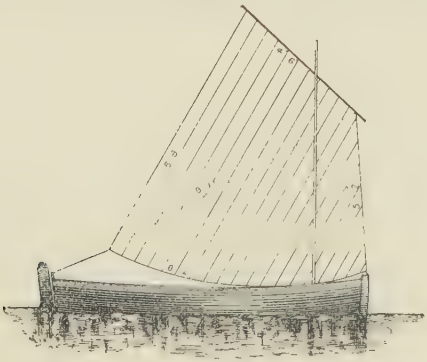
TWELVE FEET SKIFF DINGEY.



AREA OF SAILS.

Stay Foresail—11·75 square feet. Spritsail—44 square feet.

TEN FEET DINGEY FOR FIRST CLASS TORPEDO BOATS.



AREA OF SAIL.

39·5 square feet.

537. Different Methods of Building Boats.—1st. Carvel-built, which have fore-and-aft planks, the edges meeting, but not overlapping.

2nd. Clinker built, also of fore-and-aft planks, with the edges overlapping each other.

Diagonal built, having as their name implies, their planking running diagonally, the inside planks running in a contrary direction to the outside ones, and their edges meeting.

538. Heaving down.—The following account of the heaving down of H.M.S. "Formidable," 84 guns, from the "Nautical Magazine," contains an explanation of the subject.

The "Formidable" arrived in Malta harbour on the 13th of January, 1843, and received orders to prepare for heaving down; the ship was accordingly moored head and stern, with her bower chains and anchors, off the careening wharf, and cleared of everything. Not a pig of ballast, or a moveable article was left in her, with the exception of the coppers, range, and main-deck tank, which were all well shored from the ship's side, and otherwise secured. As the ship was to be hove down on the starboard side first, the hammock-nettings on that side were removed, and the partners of fore and mainmasts on upper and main decks were taken up.

Bulkheads.—The bulkheads were three in number; two were placed on the main deck—one at each end of the starboard skids, and the third was built across under the break of the poop. They were constructed in the following manner. Strong frames were nailed to the beams overhead, and deck; into these were morticed strong half round uprights, and against the flat sides of these were placed the planks

which went athwartships. The workmen commenced boarding from top to bottom, which from the sheer of the upper deck, left the space to be filled up by the last, or midship plank, in the form of a wedge; by this means, when the board was driven in, the whole thing was wedged up taut. The bulkheads were caulked and payed, then shored up behind from the beams, and from cleats nailed to the deck. All the bulkheads extended from the ship's side to amidships.

Ports.—The lower-deck ports were barred in and caulked; the scuttles in them well secured, and boarded over outside, then payed with pitch. The main-deck ports, with the exception of the four midship ones, between the bulkheads, which were left open, were boarded in with two-inch plank, then caulked, and shored up from inside to cleats on the deck.

Outriggers.—Nine to mainmast—five on lower deck, and four on the main deck; seven to foremast—four on lower deck, and three on main deck. Those on lower deck were square bulks of timber, 2 feet in the square, 40 feet 6 inches long, and were placed in ports as near abreast of the respective masts as possible; then secured by being well chocked in the ports, the heels butting against combings, bitt, &c. Where there was none, they had a heel-shore from starboard waterway, and were also secured from fetching way or rising by being well shored in every direction. The main deck outriggers, about 18 inches in the square, and 35 feet long, were placed and secured in the same manner as those on the lower deck. All the outriggers were rounded, shouldered, and cleated for rigging to butt against, at about 18 inches from the outer end.

Outrigger Martingales—were 8-inch rope, fitted with a large thimble at each end, middled and taken with a round turn over the end of the spar, then seized. Those of main deck were pulled up to short chocks in lower-deck ports ; those of lower deck to span shackles driven through ship's side, and forelocked inboard. Starboard scuttles, scuppers, and chain-pump pipe were all plugged up, and boarded over outside ; the pigeon-holes only, between main-deck bulk-heads, were filled in and caulked, being the only place where water was allowed to come.

Bilge-pumps.—Of these there were five—two in fore hatchway, two in main, and one in after hatchway. They were stepped in the lower-deck ports for wells, and the lower deck was scuttled abreast the hatchways, close in to starboard waterway, to allow the water to pass up from orlop deck to pumps. Temporary stages were erected in the square of the hatchways, for pumping party to stand on while working.

Masts—Were stripped of everything but lower rigging ; the tops and cross-trees being removed, and fished on fore and after sides ; the heads of the fishes close up to the trestle-trees, and the heels down to the lower deck—the partners on upper and main decks, being away, allowed sufficient space for their passing down. The fishes were woulded in nine places, nine turns in each lashing (3-inch rope), and well wedged up. The masts were stayed perfectly upright, but both main stays were taken on lee side of the foremast, to allow the mast to come well over on port side. The upright shores of mainmast were three in number ; the first and largest was a rough 22-inch spar, and went up within 6 inches of the trestle-trees, the head being chamfered out to allow it

to rest against the bibs ; the second was placed in a third lower down ; and the last, between the head of the second and the deck. They were all secured to the mast by a head lashing, and had also horizontal shores between them and the mast, of pieces of oak plank, about $2\frac{1}{2}$ inches thick, placed wherever the belly-lashings were passed, and proved an immense support to the mast. Of these horizontal shores and belly lashings, there were three on the long shore, and one on each of the others. All the heels of the upright shores rested on a thick helm plank laid along the waterways ; the deck being well shored underneath.

Preventer Rigging—For mainmast consisted of eight shrouds and one pendant, 13-inch rope, fitted with a long and short leg, and an eye spliced into the end of each. In placing them over the mast-head, the long leg went foremost, as it set up to the foremost lower deck outrigger ; the short one to foremost main-deck outrigger.

Two pair of shrouds were placed first, to form a bolster for the purchase block ; then remainder of the shrouds ; lastly, the pendant with a lashing-eye. The rigging was pulled up by double 20-inch blocks, double stropped, the bight of the shroud taken through the strop and toggled. The lower block strop went over the head of the outrigger ; and the falls were of 7-inch rope. The foremast was secured precisely the same as the mainmast, excepting that it had but one fish, and that on the after side ; seven shrouds of 13-inch rope ; two upright, and three horizontal shores, and belly lashings ; and both fore and mainmasts had, when secured, runners and tackles steadied forward to assist the stays. The heels of fore and mainmasts were well shored in the hold on port side.

The mizen mast was stripped of everything, the same as the other masts, excepting that the cross-trees were left on ; and the only support given to this mast, beyond its own rigging, consisted of the sail-tackles from mast-head pendants, hooked to the weather chains, which took some strain off the rigging.

Setting up Rigging.—The masts were steadied over against the port lower-deck partners, the wedges having been removed ; the starboard rigging was then pulled up for a full due, the preventer rigging pulled up with luffs on their own falls, and secured to the toggles. The standing part of the fall went with a running eye over the end of the outrigger, and the preventer rigging was pulled up last.

Mast-head Purchase Blocks.—Main purchase block, 40 inches ; main small ditto, 30 inches ; for ditto, 40 inches ; all treble sheaved, and treble stropped. The 40-inch blocks were, in the first place, double stropped with 9-inch cable laid rope, with a long eye to take the turns of the lashing ; and they had also a preventer strop of 9-inch rope, long enough to go round the mast-heads, where they were secured with two lashing-eyes. The 30-inch block was double stropped with 8-inch, and with a 9-inch preventer fitted as above. The purchase blocks were lashed at mainmast-head after the first two pairs of shrouds were placed ; and at the fore, after the first pair of shrouds. As there were two main purchases, the largest was lashed on foremost quarter of mast-head, and the smaller one on the after quarter, but no shrouds were between them. The lashings were selvagees, 500 new yarns, 30 fathoms long ; those for preventer strop were the same size, but not so long, and had been used before. In lashing the blocks, the fore and main runners were used in the follow-

ing manner:—Supposing the main to be the block to be lashed, the fore runner pendant block was lashed at foremast head, and the runner taken to the mainmast head; the tackle was hooked up and down to the foremast, and had a tricing line on upper block from the mast-head, to overhaul the runner after it had been pulled up; the selvagee was middled, and seized to the strop in the eye; one end was passed round the mast-head, through the eye of the strop, then racked to the runner pendant, which was pulled up on deck. When taut enough, and the turn of the lashing had been racked, the runner was overhauled by the girtlines and tricing-lines as before mentioned.

Pit Purchase Blocks—were double 40-inch, double stropped with 9-inch rope; the leading blocks 36-inch, single stropped. The double blocks were stropped on the bars in the pits; the leading blocks had strops long enough to go round one bar, and lash to the other, there being two in each pit.

Capstans.—Three in number, of the same sort as those used at sheers: 20 bars each, six men on each bar.

Tripping Cables—were two in number, one forward and one aft. A hemp cable, having been chafed when heaving the ship off at Barcelona, was condemned and cut in two, and used for this purpose. Two purchases of new 9-inch hawsers through treble 40-inch blocks, were rove. For the after cable one block was lashed ashore round the arches at the buildings on the opposite side of the creek, abreast the careening wharf (creek about 60 fathoms wide), and the other block was clinched to the end of the sheet cable, and then hung to a lump to keep it off the bottom. The other end of that cable

was taken under the ship's bottom, and brought up on the starboard side through a starboard upper-deck port, before the after hatchway, then across the deck, and clinched up through two parts on the port side. The fore tripping-cable was fitted the same as the after, but came through third port on the forecastle, starboard side, and made fast as before mentioned. From its leading over the chains, they were well shored up, but were burst down from the immense strain on them when the ship was half-way down.

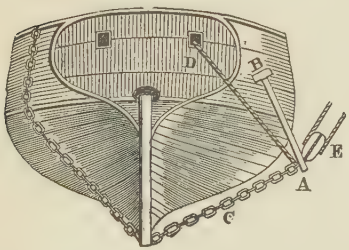
Righting Cables—were fitted the same as the above, but smaller, the stream cable being used instead of sheet. The shore blocks were lashed to bars in the pits, the cables went under the bottom, and were clinched through the port main deck ports. These were precautionary measures, no strain being ever brought upon them.

Reeving Lines and Falls—Reeving lines were new 7-inch rope, about 150 fathoms long. Falls; fore and main $10\frac{1}{2}$ inch, quite new, hawser laid rope; fall for the second main purchase, new 9-inch hawser laid rope. The $10\frac{1}{2}$-inch was reduced to $9\frac{1}{2}$ inches when unrove. The falls were 140 fathoms long, and then rather short.

When hove down the first time, they found the ship's buttocks hove her stern so high out as to be inconvenient to the workmen; therefore, before she came down the second time, thirty butts were lashed under the fore chains, which had the desired effect of keeping her keel parallel. She was kept quite free by one of Hearle's engines.

In the third vol. of the "Nautical Magazine," there is an account of an accident which happened to H.M.S. "Success,"

Captain W. Jervoise, by running on a reef of rocks at the entrance of Cockburn Sound, in 1829; to which is appended a description of the means employed for heaving her keel out for repair, by means of outriggers from the side.



A is the after outrigger, stepped in a shoe, B, which is bolted to the ship's side, abaft the main chains. The foremost outrigger is planted abaft the fore chains.

C, the after girder, secured inboard the port side, brought under the keel, and attached to the end of the outrigger.

D, the after guy, the foremost guy being led in through the gangway port.

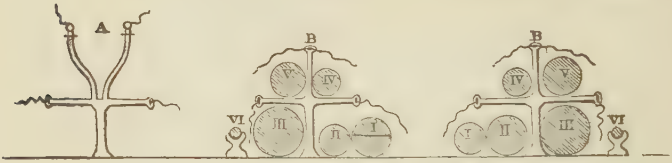
E, the after purchase block.

"The foremost capstan was taken out of the 'Success,' and fitted in the fore hatchway of His Majesty's cruiser," by which vessel the "Success" was hove out.

539. Stowing Booms.—I know of no better plan than the following, for it possesses the great advantage of allowing any one spar to be taken out without disturbing the rest. A and B are iron crutches. A is one of the foremost ones, in which the sterns of the barge and pinnace rest; and B B are the after ones, sufficiently far forward to allow play to the mizen topmast and hand-mast, when they require to be

removed. The bows of the barge and pinnace rest on crutches similar to A, but without the crosspiece.

PORT BOOMS. STARBOARD BOOMS.



Port Side.	*Starboard Side.*
I. Fishes.	I. Hand mast.
II. Hand-mast.	II. Mizen topmast.
III. Fore topmast.	III. Main topmast.
IV. Fore top-gallant mast	IV. Main top-gallant mast.
V. Jib-boom.	V. Jib-boom.
VI. Fore topsail yard,	VI. Main topsail yard.

The mizen top gallant mast is stowed on the top of the fishes ; the spare fore top-gallant yard alongside the jib-boom on the port side ; a top-mast studding-sail boom on each side ; and a couple of small spars, stowed where convenient, between the larger ones comprise the whole of the booms In the starboard main chains lies the spare main top-gallant yard, and in the port chains. the mizen topsail yard.

Iron clad ships are not often supplied with more than one spare jib-boom, topmast, or topsail yard ; small spars for boats' masts, &c., can be stowed in the hammock nettings.

540. Fire on Shore.—The following disposal of a "fire brigade for landing," was drawn up for a corvette. On the boats being called away for the above purpose, the pinnace-men will drop their boat under the main yard, ready to receive the engine and field piece limber carriage ; and the midshipman of the boat will see all the wash-deck

buckets passed into her by the boat's crew, and will be responsible for their not being lost ashore.

The gunner and his crew will provide a 100-lb. barrel of powder* (previously bored and plugged), two port-fires, or a fathom or two of Bickford's fuze in preference, if there is any, and a slow-match; pass them into second cutter; and, on landing, be in readiness to blow up any building that it may be necessary to level, to arrest the progress of the fire.

The boatswain, with forecastle-men and riggers not belonging to boats, provide fire-grapnel, and two hook-ropes; pass them into the second cutter, and, on landing, take charge of them.

The carpenter and his crew, having passed the engine gear into the pinnace, will provide a couple of axes, and go down into the boat.

The sergeant will tell off twelve men into the pinnace, under a corporal to work the engine; and fall in a corporal and eight men on the quarter-deck, in readiness, to receive ball cartridge, and then land in charge of them in the first cutter.

The lieutenant in charge will take the second gig, and be accompanied by the assistant-surgeon with provisions for accidents, and with a bugler to sound the assembly, for calling the men together at any particular spot.

All the party are to shift in their old blue clothes, and to rig in caps, shoes and stockings. On landing, they will man the drag ropes, and, with all speed transport the engine and gear to the scene of action.

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* Gun-cotton charges would be sent now.

Mr.————, will remain in charge of the boats and boat-keepers.

If the fire is not very alarming, the right thing to do will probably be seen at a glance ; but, should it already have spread to any great extent, or have caught, by the falling sparks, &c., at more points than one, with many intervening buildings, the exertions of your party cannot be efficiently directed unless you have been able to take a survey of the fire from the top of a house which commands a view of the whole. From such a position, you can see where a stand must be made to check its progress ; and, having formed your plan, let nothing divert you from its accomplishment. No time should be lost in passing out furniture, and in tearing down windows, jalousies, doors, and wooden erections of all kinds ; for, by trying to save too much, you risk the loss of all. If you have any scaling-ladders, they will be found of the greatest use ; and the range of the engine may be considerably increased by placing your thumb on the nozzle occasionally, that, on its withdrawal, the water may escape with greater force.

Wherever there are no organized fire companies, indecision is always painfully apparent. A plan is no sooner hit upon than it is abandoned for another which appears more feasible ; while the fire, in disadvantageous contrast, steadily pursues its undeviating course. Wherever, therefore, the services of his men are needed, the naval officer should promptly assume the direction of affairs.

541. RUDDERS ARE HUNG—By pintles and gudgeons ; the pintles slip into the gudgeons, which are fixed to the stern-post, and are prevented from unshipping by locking-plates.

542. Balanced rudders.—Owing to the increased size of ships, and the corresponding increase in the dimensions of rudders, immense power is required to efficiently control the helm.

To obviate this the balance rudder has been introduced into several of our new ships, and as the steering is attended with marked success; this rudder instead of hanging to the stern-post by pintles and gudgeons, steps on an extension of the keel and pivots at about one-third of its length from forward; its advantage consists in the pressure of water on the fore part, partially counteracting the pressure of water on the after part, particularly when much helm is given.

Although this form of rudder gives the most satisfactory results in ships under steam; yet, when under sail only, it has been found to retard the ship's way, and act too suddenly in stays: to meet this, an ingenious improvement has been tried, by which the advantages of a balance rudder are derived when steaming; while by simply locking the fore part it can if necessary, be quickly converted into an ordinary rudder.

543. Action of rudder.—The great thing to remember is this, that when a ship is answering her helm it is the stern being thrown round by the pressure of water on the rudder which alters her course, and that it is the head which is governed by the stern, and not the stern by the head; so much is this the case in screw ships able to give a large angle of helm, that if the helm be first put hard over and the engines started ahead, the ship will turn two or three points before gathering way.

As a general rule it may be stated that screw ships turn on a point one-third before their centre, therefore in avoiding collision when nearing the danger, steer so that your bow may go clear; having done this, as the point on which your ship pivots passes, reverse the helm, and by so doing, endeavour to throw your stern clear. The more helm given, the smaller will be the diameter of the circle made; the more speed used with the same helm, the quicker will you turn though describing a larger circle.

544. WEATHER HELM,—The centre of effort of the sails is generally abaft the centre of the vessel, the ship is pressed more against the water, on the lee side; the heel of the ship immerses the lee bow, which tends to throw the ship up in the wind.

That the amount of weather helm carried increases as the wind freshens and the ship heels more, is partly attributable to the oblique angle given to the rudder, causing it to lose much of its effect; the best practical proof may be found in boat sailing; in a steady breeze a boat can be so trimmed that she will carry a very small weather helm, but let the wind become squally, and as she heels to each puff, the small weather helm will be doubled. Weather helm may be diminished by reducing or bracing in the after sails, or by relieving her of any sail that may be pressing the bow, and by trimming more by the stern; but long screw ships will always be found to carry much weather helm when under sail alone.

545. SHIFTING A RUDDER—In the upper deck, over the rudder-head, are a couple of holes for the reception of the eye-bolts to which the tackles are suspended, which, when the plugs are driven out, are forelocked above the deck. Hook to them the upper blocks of two up-and-downs, unreeve

the falls, pay them down through the rudder-well, and reeve them through the lower blocks outside the ship ; when rove full, lead them along the deck. Shore the deck up if necessary, and run guns forward to bring her stern sufficiently out of the water to enable you to get at the wood-lock, which you un-ship. Drive an eye-bolt into the rudder, on each side, to hook the tackles to, sufficiently low down to allow the rudder to be unshipped without bringing the blocks up against the stern. Top the spanker-boom well up, hook a burton from the mizen cap to the boom-end, at which point attach another burton, overhauled down to the water. Haul up a couple of boom boats under the stern, with their stems forward ; lash them together with a spar across the bows, and another over the after thwarts, leaving sufficient space for the rudder to hang between them. Unshackle the rudder chains, man the tackles, and unship the rudder. Pass the end of a hawser from the boats, between the rudder and sternpost, and drop it down within a few feet of the keel ; knot the parts together and hook the burton to it ; then walk back the tackles, and pull up on the burton as it clears the rudder-hole. As soon as the head is clear, pass the other end of the hawser round it, walk back, and hang it to the spar across the bows of the boats ; pull up the burton, and hang the lower part of the rudder to the spar across the sterns of the boats ; unhook the tackles, and tow the boats ashore.

The new rudder is shipped by the same means, except that the burton is dispensed with, and a heel rope from the midship lower-deck ports on each side is employed to rouse the rudder to. These are fitted with long eyes, and are each passed through a hole in the heel of the rudder before it is launched ; a toggle is slipped through the eyes,

and lanyards from them are led up to the bolt for the rudder-chains, so that, when the rudder is shipped, the guys can be disengaged.

With the spanker-boom, and a runner and tackle, you may shift a rudder as follows:—Runner rove through a block on spanker-boom, cleated to prevent its slipping forward, down through a hole in the upper deck, and hitched through the tiller-hole. Tackle led along upper deck. Spanker-boom shored up; and heel of rudder lifted by burton from spanker-boom end to a lashing round rudder at water-line.

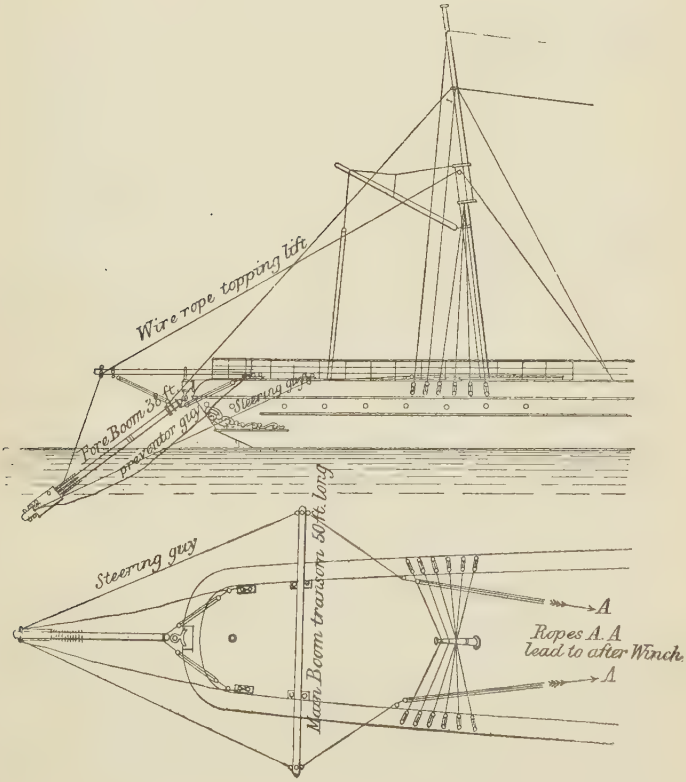
546. RUDDER DISABLED.—Veer something astern by a hawser, bend a couple of guys to the hawser, and lead them through a block on each quarter, rigged out if you have time, and get a tackle on in-board. Veer the bend a short distance astern; and, to port the helm, haul in on the starboard guy, easing the port, and *vice versa*.

Under other circumstances, the end of the largest hemp hawser may be veered astern and used.

547. USE OF RUDDER CHAINS.—These are intended as a substitute for the tiller, when it is damaged and cannot be replaced, or when the rudder-head is injured; and are worked by a tackle from the end of a short spar, rigged out of the aftermost broadside port.

548. JURY RUDDERS:—It is impossible to lay down any hard and fast rules for the construction of Jury Rudders. An Admiralty order of 1840 laid down a method of construction, in which a rudder was built upon the spare topmast, and weighted by pigs of ballast, the heel of the topmast being brought up through the rudder trunk.

Various contrivances have been adopted. On one occasion a boat's iron davit was used as a frame, to this, timber was attached by bolts and angle bars, which was placed diagonally from the top of the davit to within about one third from the heel; the heel was rove up through the rudder trunk, and the rudder fixed by extemporised pintails and gudgeons.



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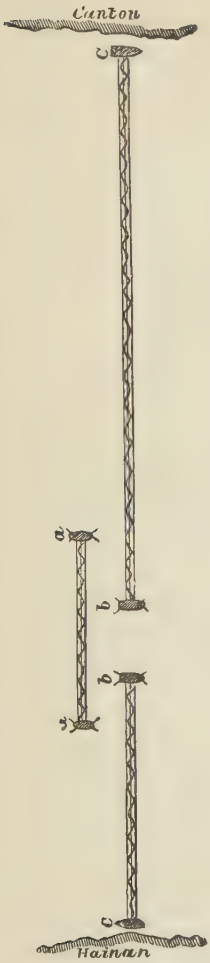
Probably as good a way as any would be, to construct a rudder on a spar by means of boiler plates, &c., and if necessary, adding more weight by securing, for example, an anchor stock to it; hang the upper end of the spar by chain taken through the rudder trunk, the after end of the rudder being supported by a tackle from a spar over the stern; steer by tackles, brought from outriggers on the quarter, and secured to the rudder.

The fore-going plates* are given as an example of a Jury Rudder. It was fitted on board the S.S. "Gloucester," whose rudder was carried away during a heavy gale when 800 miles out from Swansea. The Jury Rudder consisted of a long boom pivotted at one end to the ship, and carrying at the other end two iron doors. It was supported by a wire rope topping lift and was manipulated by two steering guys. The bracket attached to the stern of the ship was cut from the mizen mast, and fitted with a wooden back made from the lower deck hatch beams. The bracket was secured with six 1-inch bolts and by aid of two heavy slice bars extending over 3 angle frames, well backed up with hard wood. The goose-neck of the boom was shipped in the reverse way to its usual position and was secured with a collar 3-in. by $\frac{3}{8}$-in. Half an inch had to be cut out of the hole in the bracket to allow the goose-neck to revolve freely and the cotterhole was also cut.

The two iron doors fixed to the boom were taken from the 'tween bulkhead separating the forward from the main hold, and wire fastened to the boom by bolts and angle bars, stays being placed between them made from hatch bars, the whole being firmly bolted together.

* From "Engineering," (with permission.)



A boom was put athwartships through which the steering guys were led. The wire topping-lift was led forward ready to hoist the rudder clear of the water if required. The Vessel steamed safely to Port.

549. False Keel.—In the event of a ship getting ashore, the false keel will come away and free her, when more than an ordinary strain is brought upon it, and the main keel thereby remains uninjured.

550. Precautions against Fire-rafts. —The following were adopted in the Canton river, 1856-7 :—

Ships off the Factories, moored head and stern, were protected by a boom thrown across the river, above and below the position. The largest boom, above the Factories was formed of two layers of large spars, lashed together, with a stream chain laid between them, bolted to the spars on alternate sides, and the whole woulded round at intervals.

The spars were not placed so as to lock in throughout, but a small space was left every forty feet or so, to impart flexibility to the boom. At *c c* were two loaded sunken junks. At *b b* two junks moored head and stern, with long 32's mounted forward, and guns' crews on board. At *a a*, two junks, to which was attached a small boom to screen the entrance.

The ships were fortified with a spar from each bow, meeting, and lashed together at the outer ends, and drooped by a tackle from the jib-boom end. Flying-boom kept in. From these outriggers, spars were continued aft to the gangways, supported by tackles from the lower yard-arms and boomed out by spars from the ship's side, which afforded space and shelter for the boats to lie within.

From the jib-boom end was suspended a fire grapnel, or a small anchor, shackled by a length of small chain to the riding-cable, outside the hawse. This was intended to drop into the fire-vessel, and anchor her by, on the cable being slipped and the ship dropping clear.

Over the stern, an anchor was hung, which in the event of a fire vessel becoming fixed to the bows, would, on being let go, and the lower cable slipped, bring the ship up by the stern, and throw the junk off.

As wooden tanks, containing upwards of a ton of powder floating at the water's edge, were occasionally sent down, the fire booms were kept eased down, and floated on the water, and a guard boat anchored ahead.

To prevent attacks from torpedo boats, guard should be rowed round the ship at night, and one boat anchored some distance ahead of the ship, both having orders to seize any suspected boats by the stern.

551. Destruction of Booms.—Blow the boom up with a tin of gun-cotton; rouse up the bight of the chain; load with shot a launch's gun; lash the chain across the muzzle; fire, and take advantage of the result. You may even fracture a chain in the same manner with a blank cartridge.

552. Replacing Copper under Water.—With reference to this subject, the following copy of a letter has been issued by the Lords Commissioners of the Admiralty.

"Bermuda Yard, *March* 20, 1844.

"Sir,—In obedience to your directions to report the manner in which I proceeded to replace a defective sheet of copper on the bow of H.M.S. 'Hyacinth,' the same being five feet below the light water line, I beg leave to state, that on considering what means could be adopted for so doing, short of heaving the vessel out, it occured to me that the principle of the coffer-dam might be applied to it. I accordingly caused a water-tight case, of three sides and a bottom, to be made; ascertained the curve of the bow on each side of the defective part, and cut the mouth, or open side of the case to fit it; and having lined, or dressed the curved edges with felt, saturated with tallow, and attached ballast to the bottom, the case was suspended by a tackle to the rough tree rail, and lowered until the top was within a few inches of the surface, opposite the defective part, over which it was hauled by means of two hawsers, one passed vertically, from the rough tree rail, under the keel to the opposite side; the other horizontally, from the quarter, round the stern, to the opposite side, where both were set taut with tackles. By these means the case was made to fit close to the bottom, where it was further secured by a shore, reaching from the side of the ship to its outer edge, to prevent its rising. The suction hose of a fire-engine was then placed in the case, and the water contained in it pumped out; when empty, the shipwright descended, and removed the defective copper, replacing it with a new sheet. The operation, from the time

of suspending the case until completed, did not occupy more than twenty minutes.

"If I might be allowed to offer an opinion, I should say, that this principle could be applied to the repairs of many defects under water, such as the wing cocks of ships, or the pipes in the bottom of steam-vessels; and little difficulty could be experienced in this, as every vessel in His Majesty's service has the means within itself of applying the principle.

"I have the honour to be, &c.

W. Moody,

Foreman of Shipwrights."

"If you have not the requisite drawings on board, the curve of the ship's bottom outside may be approximated from a mould taken from the inside, on either side, and below the injury, up to a short distance above the water-line; and unless the case, when hove to, fits very tight, it will be necessary to chinse it in between its edge and the ship's bottom when you pump out.*

553. Lifting a Ship's Stern over the Sill of a Dock—with tanks. Rig a stage of large spars astern, lash the foremost end down to the ship at low water, and keep the after end down, and secure it, by shores from the stern and quarter.

Sling the stage by tackles, so that at low water the surface may be a few inches below the tops of the tanks, when floated underneath.

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* A sheet of copper could be quickly replaced by the ship's Diver; the above illustrates very clearly the application of the principal of the coffer-dam.

To float them under, partially fill them ; then rouse them under, and secure them : as fast as they are placed, pump them out, and watch for the rise of tide.

554. In Tow of a Steamer.—The steamer appointed to tow you, having hoisted your pendants at the fore, waits till you hoist your own pendants in reply, to indicate that you are ready, and then takes up a position ahead. You then send your hauling-lines on board by which she hauls the towing hawsers in. A longer scope in a breeze than in a calm, is of course necessary ; mats should be placed in the hawse-holes, the palls of the capstan all down, and bars swifted.

In a tideway, or in a breeze, the steamer first anchors ahead, and takes in and secures hawsers ; then the ship weighs, lastly, the steamer.

Should the breeze freshen and the sea get up, direct the steamer to veer a breaker astern, which hook and take in, that, in the event of a hawser parting, there may be no delay in hauling on board another.

When towing alongside, fore-and-aft springs should be passed, in addition to the bow and quarter lashings ; one hawser going from the after part of the ship to the fore part of the steamer, and the other reversely.

In May 1892, H.M.S. "Narcissus" towed H.M.S. "Shah," from Portsmouth to Bermuda ; the latter ship had been dismantled, and everything except the lower masts taken out of her.

She was towed at the full length (150 fathoms) of two 6 inch wire hawsers.

Although the "Narcissus" was fitted with towing bollards on the main deck, it was considered best for various reasons to tow from the upper deck. The Conning Tower forward in the Gun Battery was selected to tow from. To make the hawsers fast, the "Narcissus" used 8 shackles of her own sheet cable $2\frac{1}{8}$ (inch). The cable was middled and a complete round turn taken around the Conning Tower, the ends of the cable being brought aft, and out through two fairleads built in on the quarter, and then shackled on to the end of the wire hawsers, a swivel piece being at the end of the cable; a Senhouse slip was introduced into each part of the cable on the quarter deck, the whole being arranged so as to ensure there being nearly a length of cable outside the ship.

To prevent rendering round the Conning Tower, and to hold the "Shah" if one hawser went, Blake stoppers were put on abaft the Conning Tower and lashed to securing bollards, wire seizings and lashings were also passed round the cables at the Conning Tower, and strong cross lashings just abaft. Planking was placed along the deck under the cable, also wood chocks, or stanchions faced with iron, were placed at the after battery doors, and round the Conning Tower to take the chafe, &c.

In the "Shah," her two bower cables ($2\frac{1}{4}$ inch) were double bitted on the main deck, compressors boused to &c., the ends then led forward through a hole cut in the upper deck (lined with iron), out through the bow gun ports, swivel pieces put on each end, and the wire hawsers shackled on having about a shackle of each bower cable outside the hawse. Senhouse slips were introduced into the cable on the upper deck, to enable it to be shipped if necessary. Two spare 6 inch hawsers were supplied to the "Shah."

A crew to the "Shah" was supplied from the "Narcissus" consisting of 1 Lieutenant, 1 Sub-Lieutenant. 2 Warrant Officers, and 100 men.

The "Shah" was taken in tow at Spithead on the 10th May, the ships with the "Seahorse" in company arrived at Madeira on the 16th, coaled, and left again on the 19th, without the "Seahorse," which ship returned to England; they arrived at Bermuda on the 31st May. To tow through the Narrows, only one hawser was used, and this shortened well up. Fair weather was experienced on the passage out.

555. A SHIP IN TOW OF ANOTHER.—When the ship ahead puts her helm down, to go round, the ship in tow puts her helm up, and always endeavours to keep directly in her leader's wake.

556. BOATS IN TOW.—Dismount the gun, and place it at the bottom of the boat amidships; shift the shot boxes aft, and haul the boat *close up* under the stern—the closer the better. Tow with a hawser from each quarter, to keep her steady, and as a precaution in case one carries away. Reeve one through the shackle in the stem, take a turn round the standing thwart, and let a hand hold on to it, ready to slip in a moment; take the other also round the thwart, frapping it in slackly to the stem, (for if out on the bow, the boat would steer widly), and let it be similarly attended. Caution the coxswain to be particularly careful about the steerage: call all out of the boat but these three hands, and see the hawsers parcelled in the nips.

Watch the boat yourself from the steamer, not leaving her for a moment, and acquaint the officer of the watch should the swell of the water rise up to the gunwale, that the

steamer's speed may be slackened. If you see the water come over, do not wait till she buries herself, but give the order immediately to let go in the boat.

I had the misfortune once to be implicated in the loss of a pinnace that was stowed under, in a calm day, without a ripple on the water: and therefore know that you cannot be too careful.

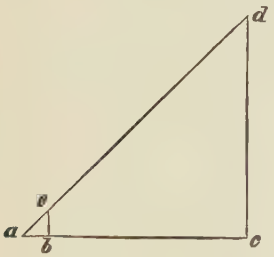
In towing a light boat, reeve the tow-rope through the ring in the bow, and secure to the bolt in the keel. If secured forward, you run the risk of tearing the bows out of her.

557. Towing Spars.—Tow with the bluff end first, for although it thus takes more force to start it, it yet requires less to maintain it in motion than with the small end fore-most you also tow nearer to the centre of gravity, and in proportion do so with greater ease and steadiness.

When towing anything in a boat, never make the tow-rope fast to the stern-ring, or even reeve it through it, as it strains the boat, and renders steering impossible, except by the oars. When the thwarts will bear it, make a bowline knot in the end of the tow-rope, and toggle it with a stretcher laid over the two after thwarts. Then, to steer the boat, lift the two-rope over towards the quarter to which you wish to turn. When the strain or jerking is heavy, secure the tow-rope to the ring-bolt for the slings in the keel.

558. Measuring Heights.—Pick a couple of sticks, or straws, and bring one to your eye, holding it horizontally. At convenient distance along it, erect the other at right angles, its height being equal to the distance along the horizontal stick from the eye to the point of section. This being done,

approach, or recede from the tree in the direction in which the ground is most level, until the top of the trunk is *on* with the top of the stick. Mark the spot; and the distance from where you are standing to the foot of the tree, is necessarily equal to the height of the tree from the level of your eye. Pace it off, or measure it in sticks' lengths to be reduced to proper measurement on your return on board; add the height of eye, and the result will be the height of the tree.



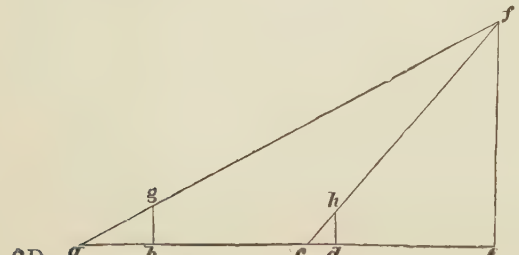
$ab : be :: ac : cd$

$ab \cdot cd = be \cdot ac$

ab, and be, being equal,

$cd = ac$.

If the foot of the tree is at the time inaccessible, bring the stick as before to your eye, and on it, at any distance, place a straw vertically; walk back from the tree until the top of the straw and the top of the tree are in one, and mark the spot. Then move the straw its own length further along the stick; walk back until the top of the straw is again *on* with the top of the tree; and the distance from this to the former station, plus the height of the eye, is equivalent to the height of the tree.



bg, and dh being synonymous,

$cd : bg :: ec : ef$

$ef \,.\, cd = bg \,.\, ce$

Again,

ab being equal to $cd + bg$.

$cd + bg : bg :: ac + ce : ef$

$ef \,.\, cd + ef \,.\, bg = bg \,.\, ac + ef \,.\, cd$ being substituted for $bg.ce$)

Then, by subtracting $ef \,.\, cd$, and dividing by bg, $ef = ac$.

559. To ascertain Distance by Sound.—The mean velocity of sound, under ordinary circumstances, is 1,110 feet in a second. In a breeze this must be corrected in proportion to the velocity and direction of the wind, though this is not generally important, as it utmost velocity is much less than that of sound. The velocity is not affected by its intensity, as the faintest sound moves as rapidly as the loudest. One of its greatest conductors is water, on which it can be heard nearly twice as far as upon land.

Multiply the number of seconds which elapse between the flash of a gun and the report by 1,110, and the product will be the distance in feet; which divide by 5,280, for an ordinary English mile; by 6,072 for a geographical mile; and by 6075·6 for a nautical mile.

560. To find the Time of Daylight and Sunset.—The morning gun is ordered to be fired at day-break, except when on foreign service, the commander-in-chief on the station shall direct otherwise.

Daybreak, or the commencement of morning twilight occurs when the sun is 18° below the horizon.

Rule.—Under the latitude put the declination, marking them with their proper names; if they are like, take the difference; if unlike, take the sum: under this, put the constant angle 108°. Take the sum and difference, add together the log, secants of the first two terms (rejecting tens in the index), and the half haversines of the two last. With the sun as a log haversine, take out the corresponding angle in time, at the top of the page, which will be the time of ending of evening twilight, and which subtracted from twelve hours, will give the beginning of morning twilight, or day-break—in apparent time.

Lat. 22° 17′ N.		Sec. 0·033708
Dec. 15 3 N.		Sec. 0·015158
7 14		
108		
115 14		½ hav. 4·926591
100 46		½ hav. 4·886675
7h. 49m.		Hav. 9·862132
12 0		
4 11	Morning twilight begins.	

Rule for finding the time of Sunrising and Sunsetting.—Add together the log, tangents of latitude and declination, subtracting ten from the index. The result will be the log, cosine of an angle in time, which if the latitude and declination are *unlike*, will be the apparent time of sunsetting, and subtracted from twelve hours, the apparent time of sunrising.

If the latitude and declination are *alike*, the angle first found will be the apparent time of sunrising, and subtracted from twelve hours, the apparent time of sunsetting.

If mean time (*i. e.* harbour time) is required, the equation of time must be applied, after the time of sunrising has been determined from sunsetting, and *vice versa*.

Lat.	22° 17′ N.	Tang.	9·612561
Dec.	15 3 N.	Tang.	9·429566
	5h. 35m.	Cos.	9·042127
	12 0		
App. time...	6 25		
Eq. time ...	0 3		
Mean time...	6 22	Sunset	

561. ROBINSON'S BOAT DISENGAGING GEAR—has been adopted as the Service fitting for boats. Certain other plans are supplied to ships, if specially asked for by the Commanding Officers, such as Hill & Clarke's, &c. Robinson's gear belongs to the class in which the release of the boat is under the control of the person in charge, and can take place at any moment selected by him or be delayed as long as he desires; it is not "self acting."

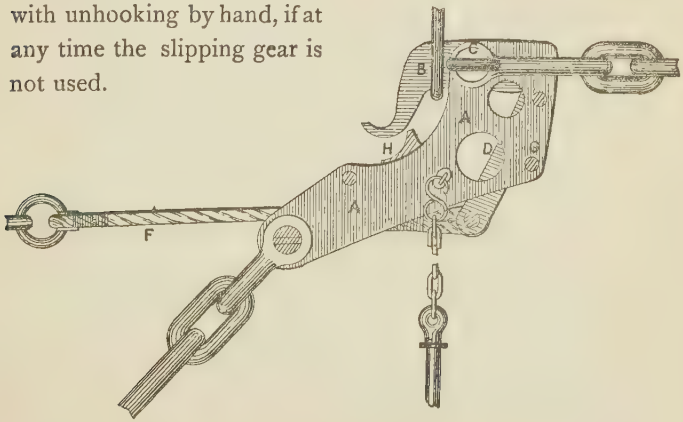
There is so little friction in the releasing gear, that it is of no importance whether the boat takes the water, or not, before slipping, and slipping is effected by releasing a small line, not by pulling it, so that a man falling against it, only lightens it. The strain on the releasing line is so small that one man is able to hold it, with the crew in the boat, without even taking the usual turn round a cleat, although it is safer to take a-half turn.

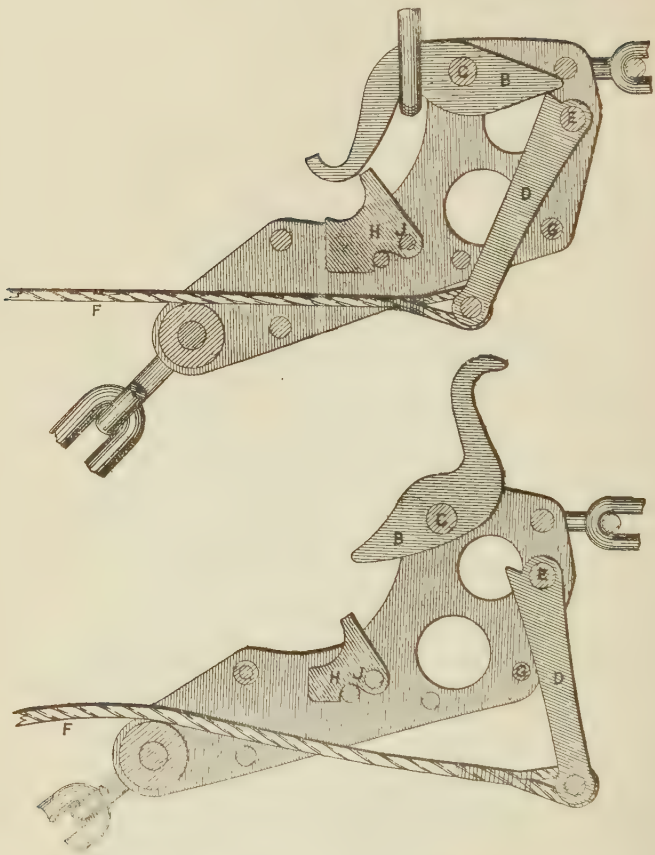
The disengaging gear consists of two tumbling hooks so connected as to tumble simultaneously on the release of a line held by a hand in the boat (with the aid of a turn round a cleat), until he thinks desirable or is ordered to let go. By

reference to the drawings and description it will be seen that when about a foot or 18 inches of the releasing line has been slacked off, the hooks are suddenly set quite free to "tumble."

The hook is of ordinary form and good size, and is safe and convenient for hooking on by, not requiring to be held up by hand, so that the man hooking on has both hands at liberty for managing the ring on the block.

By the mousing arrangement the hooks can be perfectly, and instantly moused. The arrangement for mousing shown in the drawings is such, that whether the safety pins be used or not, the boat can neither be carried away if struck by a sea when at the davits, nor become detached if left lying alongside. The mousing tumbler does not prevent slipping, and it offers no obstacle to hooking on, as it lifts freely to allow the ring to enter the hook. As it can be thrown out of action instantly by a touch of the finger, it does not interfere with unhooking by hand, if at any time the slipping gear is not used.





A, is one of a pair of plates, which are held together, at about an inch apart, by studs, or shouldered rivets, the latter serving also as stops for the working parts. The frame plates are pierced by large holes, both for lightness, and to give access to the space between.

B, a tumbling hook pivoted on C.

C, a pin which takes the form of a double ended eye-bolt to the eyes of which the steadying lines are attached. The tumbling hook B is prevented from revolving by the direct pressure against it of the short end of the lever D, which pivots on the pin E, and which in turn is held to its work by the direct pull of F.

F, is a short piece of flexible steel wire rope, (or chain). This is connected by a shackle with a light chain, or wire rope, which runs fore and aft, above the thwarts, and is divided by a single purchase, the fall of which is let go when it is desired to release the boat, the effect being, to allow the hook B to revolve from the position shown in fig, (1). to that shown in fig. (3); the boat is then set free.

G, is a safety pin, it secures the lever D, and therefore the hook, when it is desired to dispense with the use of releasing gear.

H, is a tumbler which serves to mouse the hook against accidental unhooking. It turns loosely upon the pin 3, and remains by its own weight, either in the position shown in the figs, or in a position thrown forward. In whatever position it is placed, it interferes neither with intentional slipping, nor with hooking on, and can instantly be thrown back, if it is desired to unhook by hand.

The following are some of the advantages claimed by Robinson's gear.

1. It is completely under the control of the man in charge of the boat, and no one else has anything to do with it.

2. It releases by *letting go* a line, not by *pulling* a line or lever.

3. It is immaterial whether it is slipped before or after the boat is water-borne, there being practically no friction in the apparatus, there is therefore no inducement to slip too soon.

4. It is well adapted for hooking on by, not requiring to be touched by the hand during the process.

5. It can be instantly moused, by a single mousing which interferes neither with releasing, nor with hooking on, nor with unhooking by hand.

6. It is ready for slipping again, the instant the boat is hooked on.

7. One man can take the weight off the safety pins, if used.

N.B. By a recent Admiralty Circular it is directed, that when travelling lizards and jackstays are used from the davits, the lizards are not to be made fast to Robinson's apparatus, or the boat, but are to be held by hand.

562. AWAY WITH A SEINING PARTY.—A ship's seine is about 360 feet long by 12 deep, with a purse in the centre about 16 feet deep, to confine the haul. To each end of the seine a staff is seized, weighted just sufficient to sink it; the lower part is square with the foot of the seine; and to one end of each pole a line, from 80 to 100 fathoms long (topgallant studding-sail tacks and halyards), is bent, and spanned out to the other end. This being done, the seine is payed down, and coiled away in the stern sheets of the boat; and a dingy accompanies the latter to under-run the

seine, should it catch against rocks on the bottom. On reaching the beach, a few hands remain in the boat, and the remainder stand by to man the hauling-lines. The end of one line is hove on shore, and held on to ; the boat pulls out to the extent of it, and then shoots the seine in a direction parallel to the shore, or round the space you intend to sweep, taking care that the bunt goes out clear, with the mouth open to the shore ; when all out, the boat pulls in with the other hauling-line ; then both are manned and walked away with, closing as you go. When you get hold of the poles, the lower ends are canted in, and the foot of the seine held down as it comes up.

Succeeding hauls are made in the same manner, and the ground is shifted as the fish become thinned ; pipes and fires are lit, a broil accomplished on the embers, &c.

Chapter XIV.

SALVAGE OPERATIONS.

563. Salvage.—It is impossible to lay down any hard and fast rules with regard to salvage operations, the *modus operandi* must vary according to the circumstances in which a sunk or stranded vessel is placed. The various means adopted are to a great extent common to all Salvage companies; the longest established company, with the largest plant will probably use the greatest variety of means. It is an undoubted maxim that salvage operations on a vessel should commence at the earliest possible moment; many ships have been lost owing to the time unnecessarily wasted before a definite course of action was decided upon.

The Salvage companies of the United Kingdom will not, as a general rule, undertake work on the "No cure, no pay" system around the British Coasts, whereas foreign companies uniformly work on this basis.

Between 30 and 40 years ago the Salvage work of the United Kingdom was mainly in the hands of the Liverpool and Glasgow Underwriter's Associations, assisted by a few shipbuilders. Since then Marine Insurance has steadily gravitated to Lloyds until it may now be said to be principally centred there. The system most in favour at Lloyds is for a percentage of value recovered on the "No cure, no pay" basis.

The Baltic companies have extended their sphere of operations to the Mediterranean and African shores, and occasionally compete for work in English waters. These companies possess a greater number of specially equipped Salvage steamers than as a general rule do British companies. The apparent lack of a large number of such vessels among the English firms being, perhaps, mainly due to the numerous available Craft, Tugs, Trawlers and Steam Lighters at almost every port in the United Kingdom, to the complete Railway system existing for quick despatch of plant, and to the difficulty of having Salvage steamers to suit the rise and fall of the tides which vary round the shores from 3 ft. up to 50 ft.

A List is appended of Salvage Associations and Companies.

If a vessel gets stranded, but has not knocked a hole in her bottom, among the precautions to be taken at once, are the following :—ascertain by sounding from a boat the depth of water round and near the vessel ; lay out anchors and heave in taut ; lighten the ship as much as possible by removing stores, &c. ; prepare to shore her up with spars, to prevent her falling over with the tide ; get full steam up ; and use the utmost endeavours to be ready to heave her off at the next high tide after she has stranded.

If the vessel has knocked a hole in her bottom, it may even then be possible to sufficiently close the hole by Collision Mat, or other means, to keep the water under control and bring the ship safely to port. The case of H.M.S. "Leander" may be cited ; she struck on the Hornet Rock in June, 1885, the divers succeeded in covering the hole with "Wood's patent leak stopper" and the ship was brought safely to Plymouth.

The principal means employed by Salvage companies in salving a vessel are :—

The extensive use of divers.

Great pumping power applied to the ship, after apertures and holes in the bottom, sides, and deck have been patched and tightened.

Forcing air into the ship, or its compartments, and thus displacing the water.

External floating power, either by means of lighters, pontoons, or air bags.

If the vessel is sunk under water, slinging her with flexible wire rope, or chain, and then by means of pontoons raising her with the tide, towing her in, repeating the operation till she is above water. If no tide, using screws and hydraulic power, and getting her up by fleets in a similar manner.

Building a superstructure on to the vessel, thus carrying her sides up above the surface of the water, and then pumping out.

Closing the vessel up, and pumping out ; in this case care must be taken to ascertain that the pressure of water above is not sufficient to break in the upper deck ; it may be necessary to shore the deck well up.

With regard to stopping holes and leaks, prior to pumping a vessel out ; there are many and various contrivances to overcome the great difficulties generally attendant upon this. If possible, holes are best closed from the outside, and it may be necessary either to list the ship or blast rocks out of the way. Large shields of wood are often employed ;

round the edges of the shield canvas containing oakum, or seaweed, &c., is secured, the shield being then placed by guys and divers over the hole. Shields of iron are also used, attached by clamps as necessary. Patches of brickwork, and also of cement have been used.

In many cases smaller leaks have been effectually stopped by divers applying beds, bags, seaweed, oakum, heather, straw, &c, whilst the pumps were in full action.

If the holes cannot be closed from the outside a box can be built over it, being well shored down and secured. It may even be necessary to build a platform as a false bottom over a compartment.

Lifting chains, or wire hawsers, are usually got under a vessel's bottom, by the sawing motion of a small wire or chain, to which the heavier hawser is afterwards attached and hauled round ; if on a rocky bottom, long iron rods, worked between apertures in the rocks may be used by divers to pass the lighter ropes through.

The following descriptions of successful salvages of recent date, are given as types of Salvage operations.

On 13th March, 1889, H.M.S. "Sultan"* ran on a reef off the Isle of Comino, every effort was at once made to get her off, but without success. After a few days a Levanter came on, the vessel shifted, listed over to port and sank, the upper-works and forecastle alone remaining above water. It was considered impossible to save the ship, and orders were sent from home to destroy her, but to recover the guns. In May the work of demolition commenced. At the end of May

*Messrs. Baghino & Son, of Genoa, have kindly furnished these details of the Salvage of H.M.S. "Sultan."

and before much had been done in this direction, the Salvage Firm of Messrs. Baghino & Son. of Genoa, contracted with the Admiralty to raise the Vessel at their own risk, and to bring her to Malta.

In the beginning of June, work was commenced by blasting away the rocks on the starboard side of the ship, when eight large apertures or fractures were discovered below the armour belt ; to close these, cross frames of timber were bolted on, the frames built over with brick and cement, and the whole then covered with stout planking.

At the same time all gun ports, and other small apertures, were closed up, and the deck which had been blown up in order to get out the battery guns, was temporarily repaired.

Caissoons, or coffer dams, constructed of wood, were built up over certain port-holes, 3 pumps were placed on the poop, and 2 on the forecastle, with a pumping power of about 3500 tons per hour, and on the 26th July pumping operations were commenced ; the pumping power not being sufficient, 2 Gwynne pumps were forwarded from Genoa. These arrived on the 7th August, the pumping power was then raised to 5000 tons per hour. The result was good, as the main deck was freed, thus enabling the work of closing up the interior of the ship to be more completely carried out.

The stern of the ship then raised, but the forepart seemed immovable ; on a careful examination by divers, 2 large Kingston valves were discovered broken near the keel, forward.

By the 20th August these were repaired and the fore part of the ship was sensibly raised. It now became necessary to place the pumps so as to work on the main deck; this was a difficult job, and it was eventually found necessary to limit the pumping power to those pumps which were provided with india-rubber tubes.

Other causes of delay arose from the pumps wanting repairs, &c., also strong N.W. winds prevailed, and prevented the salvage steamers "Utile" and "Rapide" from lying close to, in order to provide the necessary steam for the pumps.

The ship was now afloat, but on the 23rd August a strong Levanter coming on, drove her on the reef again, causing one of the artificial closures to be badly damaged and in consequence the ship to sink. On the weather moderating the damage was repaired, pumping again commenced and on the 25th August the ship was floated and towed to Malta. She was there docked, temporarily repaired, and on the 10th December, steamed to England.

In March, 1891, the "Utopia" when steaming into Gibraltar anchorage, fouled the ram of H.M.S. "Anson," which ship was at anchor, rent a large hole in her own side, and sank in 9 fathoms of water, her funnel and masts alone remaining visible above water.

The East Coast Salvage Company, of Leith*, undertook to raise her. They at once commenced to build a superstructure on to her, the object being to run her sides up to

* I am indebted to Mr. Thos. N. Armit, the Manager of this Company for notes on Salvage work.—T. P. W.

above water. Very little boring or drilling was required to be done by the divers in fixing the the lower timbers, as they were clamped to the vessel's bulwarks by large screw clamps, somewhat similar to the ordinary clamps used by joiners. The superstructure was built of wood, being well secured by cross stays and struts, the sides covered vertically with planks 6 inches thick, and the whole then covered with canvas. The structure was made strongest at the stern, 7-inch timbers were used, strengthened by horizontal angle irons shaped to the stern. The foot of the planking was stepped into a gutterway of double angle irons shaped to the taffrail. The superstructure was about 24 feet high aft, and 13 feet forward.

The hole made by the ram of the "Anson," roughly 20 feet long and 15 feet wide, was sheathed over with oak planks bolted and screwed on.

Powerful pumps were placed on the superstructure and pumping commenced on the 8th of July, the Vessel was raised till the whole of the superstructure was above water, the pumps were shifted on to the deck of the Vessel, the superstructure taken down, and the Vessel then completely pumped out.

The floating and removal of the broken and submerged wreck of the steamer "Wick Bay," in 1893, from the fairway of King's Lynn Channel, forms an interesting case of Salvage Engineering.

After various attempts extending over a period of four years the East Coast Salvage Company undertook the work. About 3000 to 4000 tons of mud were extracted from the holds of the vessel, by a manipulation of the suction hoses

of the steam pumps, after which the collapsed main deck of the bow portion of the wreck was strengthened by logs of timber laid under water by divers. A large caisson was built inside the engine room, and boiler space, and attached to the broken portions of the vessel. The whole was then pumped out and floated away on its broadside.

A wooden superstructure 29 feet deep, was erected upon the stern part of the submerged vessel, which was then pumped out, floated, and removed.

A somewhat peculiar example of salvage operations was that of tying a broken steamer together with steel wire hawsers, much after the manner of the strings over the bridge of a fiddle. The vessel "Sea Spray," of Glasgow, broke in two by the scour of the Mersey, in 1897. The fractures were 3 feet wide at the gunwhales and extended V shaped to below the bilges. Heavy plate girders were bolted over the broken sheer strakes, and four parts of 7 inch steel wire hawsers attached to each end of the steamer were set up taut by wedging over a strong gallows in amidships. The vessel was pumped out and floated.

The steamer "Locksley Hall" when entering the Mersey in February, 1887, fouled a ship at anchor, and then sank. A syndicate was formed in London to raise the Vessel; her displacement was about 1000 tons and she had cargo on board to the extent of 1400 tons.

Salvage operations commenced early in May. Four lifting hulks, two of wood, and two of iron, well strengthened

internally by timbers, were moored over the sunken vessel. The lifting ropes used were 7-inch and 9-inch steel wire (Bullivant's), which were passed round the vessel, being placed in position by divers, and see-sawed into the required place under the hull by tugs, and at low tide secured to the hulks; the deck of the vessel was 9 feet below the surface.

On the 14th June the first lift was made; the hulks, rising with the tide, lifted the vessel, and she was towed into shallower water. The operation was repeated, and the work finished by the 21st June.

Another similiar case of Salvage may be quoted, viz; that of the paddle steamer "Wolf," which sank in Belfast Lough, in about 7 fathoms of water. She was slung by chains from caissons or pontoons; the rise and fall of the tide being only 9 feet, the wreck had to be continually moved for short distances and grounded, the number of tides in which the vessel was actually moved was fifteen; in all she was lifted some 40 feet, and towed 10 miles.

In November, 1892, H.M.S. "Howe," ran ashore when entering Ferrol Harbour and sank. She was successfully raised by April, 1893, and placed into dock at Ferrol for temporary repairs, and then steamed to England. The usual means as indicated in the former part of this article were adopted to salve her. The salvage company employed have expressed a wish that the details of their operations should not be published.

LIST OF SALVAGE ASSOCIATIONS AND COMPANIES.

Amsterdam Salvage and Towing Co.	Amsterdam.
Baltimore Wrecking Co.	Baltimore.
Baxter Wrecking Co.	New York.
Berging Maatschappi.	Maasluis.
Boston Tow Boat Co.	New York.
do. do.	Vineyard Sound.
British Marine Salvage Co.	Glasgow.
Brooks, G. W.	Liverpol, N. S.
Bugsir Gesellschaft Union	Bremen.
Chapman Derrick and Wrecking Co. ...	New York.
Chittagong Port Commissioners ...	Chittagong.
Cia Trasatlantica	Cadiz.
Cie de Remorguage, etc.	Paris
Clyde Salvage Association.	Glasgow.
Conyers, J. A.	Bermuda.
Cowasjee, Dinshaw and Bros.	Aden.
Darrell, J. S.	Bermuda.
Davis Coast Wrecking Co.	New Beford.
Diving Co, ...	Constantinople.
Dougherty and Co.	Baltimore.
East Coast Salvage Co.	Leith.
Gann's Salvage Co.	Whitstable.
Genoese Marine Salvage Association. ...	Genoa.
Gollcher & Sons, (Lloyd's Agents.) ...	Malta.
Grech, Vincent	Dardanelles.
Grech, Pascal	Malta.
Hall, A. & Co.	Aberdeen.
Hamilton, Chas.	Kertoh.
Independent Marine Salvage Co. ...	Liverpool
International Salvage Union.	Copenhagen.
Irvine & Son. (Lloyd's Agents.) ...	West Hartlepool.
Kurrachee Port Trust	Kurrachee

Lowe, E. R.	New York.
Luckenbach, F.	,,
Madras Harbour Trust	Madras.
Marine Salvage Association	Victoria.
Mavrogordato and Logothettis	Saganrog.
Merritt's Wreckage Organization	Baltimore.
,, ,, ,, ...	New York.
Meyer, W. E. & Co.	Bermuda.
Morris, Maull, Burton & Company. ...	New York.
Moran Towing Company	,,
Neptun Salvage Company	Stockholm.
Nordischer Bergung Verein...	Hamburg.
North of England Insurance Company ...	Newcastle.
Northern Salvage Company	Hamburg.
Norwegian Salvage, and Diving Company ...	Christiana.
Olsen's Diving Company....	Bergen.
Perim Coal Company	Perim
Ratner, Samuel	Ochakoff.
Red Star Tug Service	Philadelphia.
Rodriguez, Cazenave, & Co.	Monte Video.
Russian Steam Navigatin Company.	Odessa.
Salvage Association	Glasgow.
,, ,, ...	London.
,, ,, ...	Liverpool.
Scott, T. A.	New York.
Smit, L. & Co.	Alblasserdam.
Societè Italiana di Salvitaggi Marittimi ...	Genoa.
Societè des Remorgueurs	Constantinople.
South of Europe Salvage Association, (Sons of Thos. Haynes.)	Gibraltar.
Svitzer Salvage Company.	Copenhagen.
Svorono, C. & Sons.	Kertch.
Svorono and Forsdyke	Saganrog.
Thomas Luke, & Co., (Lloyd's Agents) ...	Aden.
Underwriters' Association.	Sydney.
Vladikavkaz Ry., Company.	St. Petersburg.
Whitelaw, T. P. H.	San Francisco.

As an example of the Plant required by a Salvage Company, that of the Neptune Salvage Company is given; it is as follows :—

Ten Steamers built and fitted out for Salvage purposes. Six of these vessels are fitted with electric light and submarine electric lamps.

Seven fixed Centrifugal pumps each with a discharging capacity of from 1800 to 3000 tons of water per hour.

Fifteen portable steam pumps with portable boilers, each with a discharging capacity of from 450 to 800 tons per hour.

Two Centrifugal pumps worked by electricity, each with a discharging capacity of 1500 tons per hour.

Twenty-five complete diving apparatuses for steam and for hand, the same being fitted with telephones.

Four cylindrical iron pontoons with a lifting capacity of 450 tons.

Two rectangular iron pontoons with a capacity of 2400 tons.

Four wooden pontoons with a lifting capacity of 600 tons.

Forty hydraulic jacks each with a lifting capacity of 100 tons.

1800 fathoms of 9 inch steel wire hawser tested to 320 tons.
200 fathoms of Jalles chain tested to 320 tons.
100 fathoms of $2\frac{1}{2}$ inch chain cable.
} for lifting purposes.

Sea-going hulks fitted with steam cranes.

Sea-going lighters of different sizes fitted with lifting cranes.

Submarine blasting materials, and rock drilling machines.

Purchases of heavy dimensions, &c., &c.

The following companies have kindly furnished information about Salvage work generally, viz :—

Svitzer Salvage Co. (Copenhagen.)
East Coast Salvage Co (Leith.)
G. Baghino & Co. (Genoa.)
Northern Salvage Co. (Hamburg.)
Salvage Association of London.
North of England Steamship Insurance Association. (Newcastle.)
Neptune Salvage Co. (Stockholm.)
Marine Salvage Co., of Victoria. (Melbourne.)

TABLE I.

For Ascertaining the Strength of Hawser-laid rope.

Size.	No. of Yarns.	Weight of lbs. of 100 Fathoms.	Strain in Tons.		
			Maximum.	Minimum.	Mean.
† 12	1173	2940	45·5	35·0	40·0
11½	1077	..	41·7	32·0	36·7
11	987	...	38·2	29·3	33·6
10½	900	...	34·9	26·7	30·7
10	816	2136	31·7	24·2	27·9
9½	738	...	28·6	21·8	25·2
9	660	1712	25·7	19·6	22·6
8½	591	...	23·0	17·5	20·2
8	522	1379	20·4	15·5	18·0
7½	459	...	18·0	13·6	15·8
7	399	...	15·8	11·8	13·8
6½	345	...	13·7	10·2	12·0
† 6	294	834	11·7	8·7	10·3
5½	249	712	9·8	7·3	8·7
5	204	..	8·2	6·1	7·2
4½	168	413	6·7	5·0	5·9
4	132	...	5·3	4·0	4·7
3½	102	...	4·1	3·2	3·7
3	75	203	3·1	2·4	2·8
2¼	54	...	2·2	1·8	2·1
2	33	...	1·5	1·3	1·4
† 1¾	27	...	1·28	1·13	1·23
† 1½	21	...	·90	·86	·88
† 1¼	15	...	·60	·53	·56
† 1	12	...	·58	·46	·51
† ¾	9	...	·51	·42	·46
† ½	6	...	·28	·28	·28
		...			

† The lines thus marked contain the results of actual experiments, and the interrmediate lines those derived from calculation.

TABLE II.*

Showing the Strength of Blocks.

Descriptions of blocks common single, thick	Strain which each block ought to bear	The size rope to reeve in each block.	The strain the rope will bear.	The size of strapping for each block.	Remarks.
Inches	Tons.	Inches.	Tons.	Inches.	A common thin block reeves a rope one-third the length of the block. A clump block, half the length. A thin block, one-fifth A fiddle block, one-sixth. The stropping of a single block is one third the size of the block. For instance the stropping of a 6-inch block is of 2-inch rope ; of a 15-in. block, 5-inch rope, &c. Double blocks require double strops ; and threefold blocks either a double strop of larger rope or a single preventer strop in addition to the double one. Although a single block has the same sized pin as a double or a treble block, it must not be inferred that a single block will sustain an equal strain with a treble block. A treble block is in fact three blocks in one and the weight distributed between them renders it, capable of sustaining three times the weight of a single block of corresponding size.
6	1⅛	2	11-16	2&2¼	
7	1¼	2½	1⅜	2¼&2½	
8	14-5	2¾	1¼	2¾	
9	1⅞	3	2¼	3	
10	23-5				
11	3¼	3½	3	3&3½	
12	4½	4	4	4	
13	5¼				
14	5⅞	4½	5½	4½&5	
15	6½	5	6¼	5	
16	7¾	5½	7½	5½	
17	8¼				
18	9¼	6	9	6	
19	10¼	6½	10	6½	
20	11⅝				
21	12½	7	12	7	
22	13⅜				
23	14½	7½	14	7½	
24	16½	8	16⅛	8	
25	18				
26	20½	8½	18	8½	
27	22	9	20½	9	
28	24	9½	23	9⅛	

* Bushell's "Rigger's Guide."
(A Valuable little book.)

TABLE III.*

SHOWING THE MEAN STRENGTH AND ELASTICITY OF CERTAIN MATERIALS.

MATERIALS.	C.	S.	E.	M.
WOODS.	lbs.			
†Ash	17000	2026	6580000	4988000
Beech	11500	1560	5417000	4457000
Deal, Christiana ...	11000	1550	6350000	5378000
—— Memel	11000	1730	6420000	6268000
†Elm	5780	1030	2803000	3007000
Fir, New England ..	12000	1100	5967000	6249000
—— Riga	12600	1130	5314000	4080000
—— Mar Forest ...	12000	1140	3400000	2797000
Mahogany	8000			
Norway Spars ...	12000	1470	5830000	5789000
Oak, English { from	9000	1200	3490000	2782000
Oak, English { to	15000	2260	7000000	4702000
—— Adriatic ...	14000	1380	3880000	2257000
—— African... ..	14400	2000	9500000	5583000
—— Canadian ...	12000	1760	8950000	5674000
‡Poon	14000	2200	6760000	6488000
Pine, Pitch	10500	1630	5000000	4364000
—— Red	10000	1340	7360000	6423000
‡Teak...	15000	2460	9660000	7417000
IRON.				
Iron, cast { from	16300	8100	69120000	5530000 §
Iron, cast { to	36000			
—— Malleable ...	60000	9000	91440000	6770000 §
—— Wire	80000			

* From the "Mechanic's Pocket Guide." † Of English Growth.

‡ East Indies. § Mean of English and Foreign.

The application of this Table at the end of Article 532.

TABLE IV.

THE PROPORTION WHICH EACH PART OF A MAST OR YARD BEARS TO THE GIVEN DIAMETER.

SPECIES	Heel.	Quarters.			Head.		Pole, Yardarms or Ends.
		1st.	2nd.	3rd.	Lower Part.	Upper Part.	
Lower masts	$\frac{5}{6}$	$\frac{60}{61}$	$\frac{20}{21}$	$\frac{8}{9}$	$\frac{4}{5}$	$\frac{2}{3}$	—
Topmast	—	$\frac{60}{61}$	$\frac{20}{21}$	$\frac{8}{9}$	$\frac{5}{7}$	$\frac{5}{9}$	—
Top-gallant-masts	—	$\frac{60}{61}$	$\frac{20}{21}$	$\frac{8}{9}$	$\frac{4}{5}$	—	$\frac{5}{9}$
Yards	—	$\frac{40}{41}$	$\frac{9}{10}$	$\frac{3}{4}$	—	—	$\frac{1}{2}$
Bowsprit	$\frac{5}{6}$	$\frac{40}{41}$	$\frac{10}{11}$	$\frac{7}{9}$	—	—	$\frac{5}{9}$
Jibboom	—	$\frac{60}{61}$	$\frac{13}{14}$	$\frac{5}{6}$	—	—	$\frac{2}{3}$
Driver-boom	—	$\frac{60}{61}$	$\frac{15}{16}$	$\frac{11}{13}$	—	—	$\frac{7}{10}$
Gaff	—	$\frac{40}{41}$	$\frac{10}{11}$	$\frac{7}{9}$	—	—	$\frac{5}{9}$

TABLE V.

Proportional Dimensions of Tops, Caps, and Cross-trees.

Species.	Length.	Breadth or Width.	Depth or Thickness.
Tops	$\frac{2}{3}$ the breadth at fore cross-tree ...	At fore cross-tree, $\frac{1}{3}$ the whole length of the topmast. After part $\frac{3}{25}$ the length of the topmast.	
Trestle-trees...	Length of the top fore-and-aft, or $\frac{2}{5}$ the whole length of the topmast	Two-thirds of the depth	$\frac{1}{16}$ of an inch to every foot in length
Fore cross-tree	$\frac{60}{81}$ of the breadth of the top at the fore part of the square hole ...	Same as that of the trestle-trees ...	$\frac{2}{3}$ of their breadth.
After cross-tree	$\frac{30}{31}$ of the top at the after part ...		
Lower cap ...	Wood left before the round hole is $\frac{2}{3}$ the depth of the cap. Wood abaft the square hole the depth of the cap	Two diameters of the topmast, and one inch	One inch less than the diameter of the topmast.
Bowsprit cap...	Five diameters of the jib-boom ...	Twice the diameter of jib-boom	$\frac{5}{6}$ diameter of jib-boom.
Topmast cap...	In the same proportion to the top-gallant mast, as lower cap is to topmast.		
Trestle-trees...	Seven-twelfths of the lower trestle-trees		
Cross-trees ...	After horn, $\frac{2}{3}$ of the lower after cross-tree. Foremost horn, $\frac{5}{6}$ of the after one	The breadth of the trestle-trees ..	$\frac{4}{5}$ of the breadth.

VI.—MISCELLANEOUS.

3	Inches	1 palm
4	Inches	1 hand.
9	Inches	1 span.
18	Inches	1 cubit.
5	Feet	1 pace.
6	Feet	1 fathom.
120	Fathoms (strictly 126½ fathoms)	1 cable's length.
8	Cables' length	1 nautical mile.
600	Square feet of inch boards	1 load.
40	Cubic feet of round timber	1 ton or load.
50	Cubic feet of hewn timber	
1000	Billets or	1 cord of wood.
8	Cubic feet, or	
10	Cwt.	
108	Cubic feet	1 stack of wood.
630	Lbs, or	1 fathom of wood.
6	Ft × 6 ft. × 2 ft	
84	Lbs	1 bushel of coals.
2	Cwt.	1 sack of coals.
10	Sack (42 in. by 30 in.)	1 ton of coals.
40	Cubic feet	1 ton of shipping.
120	Deal of nails	1 hundred.
6	Stone of new hay	1 cubic yard.
9	Stone of old hay	
36	Lbs. of straw	1 truss.
56	Lbs. of old hay	
36	Trusses	1 load.
8	Lbs. of meat or fish	1 stone.
56	Lbs. of butter	1 firkin.
236	Gallons sweet oil	1 ton.
252	Gallons fish	
24	Sheets of paper	1 quire.
20	Quires	1 ream.

WATER AND PROVISIONS.

Water.

1 Ton = 35·84 cubic feet—224 galls. (210 galls. Victualling Yard.)
1 Cwt = 1·8 Cubic feet—11·2 galls.
1 Gallon = 277·2738 cubic in.—10 lbs. avoirdupois—7000 gr. Troy.
1 Cubic Foot = 997·137 oz. avoir. temp. 62° - 62·5 lbs. - 6·25 galls.
1 Cubic inch = 252·458 grains avoirdupois, temp. 62°.
1 Cylindric Foot = 49·1 lbs.
1 Cylindric inch = ·02842 lbs.

Contents of Cask.

Leager	164 gallons
Butt	110 ,,
Puncheon	72 ,,
Hogshead	54 ,,
Barrrel	36 ,,
Half-hogshead	25 ,,
Kilderkin	18 ,,

Tanks.

No.	Galls	Length. ft.	Length. in.	Breadth. ft.	Breadth. in.	Depth. ft.	Depth. in.	
1	600	4	1	4	1	6	1	Whole
2	500	4	1	4	1	5	1	,,
3	400	4	1	4	1	4	1	,,
4	200	4	1	2	1	4	1	Half.
5	200	4	1	4	1	2	1	,,
6	193	4	1	4	1	2	1	(corner off.)
7	200	3	3	3	3	3	3	,,
8	100	3	3	1	8	3	3	Quarter.
9	100	3	3	3	3	1	9	,,
10	375	4	1	4	1	4	1	Bilge.
11	264	4	1	3	7	4	1	,,
12	110	3	3	2	7	2	10	,,

Ballast.

Runs 7, 18, 20, and 40 to a ton. There are two sizes of 20, one being shorter and thicker than the other.

Provisions.

Biscuit	Bags	112 lbs.
	Cases	100 ,, 50 & 30 lbs.
Rum	Puncheon	72 gallons.
	Hogshead	54 ,,
	Barrel	36 ,,
	Half-hogshead	25 ,,
	Kilderkin	18 ,,
	Small Cask	12 ,,
Salt Beef	Tierce	38 8-lb. pieces.
	Barrel	26 ,,
Salt Pork	Tierce	80 4-lb. pieces
	Barrel	52 ,,
Flour	Barrel	336 lbs.
Suet	Half-hogshead	250 ,,
	Half-hogshead	168 ,,
	Small-Cask	70 ,,
	Ditto	56 ,,
Raisins	Case	112 ,,
Peas	Barrel	320 ,,
	Half-hogshead	230 ,,
	Kilderkin	160 ,,
	Small Cask	80 ,,
	Cylindrical Cask	180 ,,
Oatmeal	Half-hogshead	250 ,,
	Kilderkin	170 ,,
	Small Cask (12 gallons)	110 ,,
	,, ,, (10 ,,)	50 ,,
	Cylindrical Cask	200 ,,
Sugar	Barrel	392 ,,
	Half-hogshead	280 ,,
	,, ,,	112 ,,

Chocolate Ordinary	Cases No. 1	100 lbs.
	,, No. 2	50 ,,
Chocolate Soluble	Cases No. 3	50 ,,
	,, No. 4	25 ,,
Tea	Chest	83 lbs.
	Half-chest	36 ,,
Vinegar	Puncheon	72 gallons.
	Hogshead	54 ,,
	Barrel	36 ,,
	Half-hogshead	25 ,,
	Kilderkin	18 ,,
	Small cask	12 ,,
Tobacco	Barrel	150 lbs.
	Half-hogshead	90 ,,
Soap	Case	100 ,,

TABLE VII.

MEASURES OF LENGTH AND SOUNDINGS USED IN FOREIGN CHARTS.

French.

In French Charts the Mètre is almost invariably used.

Occasionally on Plans of Harbours, the soundings are given in Pieds (=1.094 English feet.)

In the older Charts the soundings are given in Brasses or fathoms (=5.329 English feet).

The following Table will be of service.

Conversion of Mètres into English feet and fathoms.

1	Mètre	= 3·2809	Eng. feet	=0·5468	Eng. fath.
2	,,	= 6·5618	,,	=1·0936	,,
3	,,	= 9·8427	,,	=1·6404	,,
4	,,	=13·1236	,,	=2·1873	,,
5	,,	=16·4045	,,	=2·7341	,,
6	,,	=19·6854	,,	=3·2809	,,
7	,,	=22·9663	,,	=3·8277	,,

8 Mètre = 26·2472 Eng. feet. = 4·3745 Eng. fath.
9 ,, = 29·5281 ,, = 4·9214 ,,

By removing the decimal point as required, this Table admits of extensive application :—thus 375 mètres = 984·27 + 229·66 + 16·40 = 1230·33 feet,—or 164·04 + 38·28 + 2·73 = 205·05 fathoms.

1851·852 mètres = 1 nautical mile ; and 5·5555 kilomètres = 1 sea league.

RUSSIAN.

Russian foot is equal to.. .... 1·145 English feet.
(Sea) Sashine... ....6·000 ,,
Arshine..... ....2·33317 ,,
Verst... .. ..0·66287 mile.

SPANISH.

Spanish foot (pié) is equal to.....0·9142 English feet.
Braza..... .... 5·485 ,,
Vara..... ....2·74252 ,,
Mètrs..... ....3·281 ,,

DANISH.

Danish foot (fod) is equal to ..... 1·0297 English feet.
Favn... ....6·1783 ,,
Mile .. ..4·68 English miles.

DUTCH.

Dutch Palm (= 1 French Dècimètre) is equal to 0·32809 English feet. Also, the Dutch Elle = 1 Mètre ; and one Elle = 10 Palmer = 101 Düimen, and the Vaden = 5·905 English feet.

SWEDISH AND NORWEGIAN.

Swedish foot (fot) is equal to..... ....0·9741 English feet.
Meter . ...3·281 ,,
Famn ... .5·844 ,,
Meter..... .. ..3·281 ,,
Favn.... ....6·176 ,,
Norweigan Foot (fod) is equal to .....1·0924 ,,

GERMAN.

Meter is equal to... . ...3·281 English feet.
Geographical mile is equal to..... . .....4·00 ,, Naut. mls.
Ruthen..... .... 4·064 ,, ,,

ITALIAN.

Metro is equal to	3·281	English feet.
Mile	1·000	,, mile.

AUSTRIAN.

Meter is equal to	3·281	English feet.
Faden	6·223	,,

BELGIAN, CHILIAN, and PORTUGUESE.

Metre, or, Metro, is equal to	3·281	English feet.

JAPANESE.

Fathom is equal to	6·000	English feet

UNITED STATES.

Fathom is equal to	6	Feet.

APPENDIX.

BRIEF

INSTRUCTIONS

FOR OFFICERS OF THE

MERCHANT SERVICE.

By W. H. ROSSER.

REVISED AND ENLARGED

By T. P. W.

BRIEF INSTRUCTIONS FOR OFFICERS OF THE MERCHANT SERVICE.

MASTER'S NAME ON SHIP'S CERTIFICATE OF REGISTRY.*—On being appointed by the owner to the command of a vessel, you must forthwith see your name put on the Ship's Certificate of Registry as Master, in any port of the United Kingdom this will be done at the Custom-house, and the "Merchant Shipping Act" (with which every Shipmaster ought to be provided) will give you information as to the persons who are deemed Registrars in the Colonies and elsewhere. It is unnecessary to give the form of this Certificate here, as it is supplied in the "Act"; it is a parchment document which the master must retain and have at hand for production when required, as for instance at the Custom-house on the vessel arriving at a Port, on leaving Port, &c., and it is to be used only for the lawful navigation of the ship.

It should be borne in mind that the owners of a ship have always the power of superseding the master (provided he is not part owner) at any time they please; and the master upon being so superseded, is bound to deliver up the ship's certificate of registry to his successor,—the

* For Merchant Ship's Papers required to be carried Vide Page at end of this Chapter.

penalty of improperly retaining it being £100. Should the master be superseded without good cause, he has his remedy against the owners for any loss or damage accruing to him.

CHARTER-PARTY.—The Charter-party is a contract "by which an entire ship, or some principal part thereof, is let to a merchant for the conveyance of goods, on a determined voyage to one or more places." It is not required to be drawn up in any precise form of words; this depends on the circumstances and character of the voyage, for as there are generally peculiar regulations and customs attached to special trades, so there must be a corresponding diversity in the form and terms of the Charter-party; thus, it must be so framed and worded as to suit the wishes and intentions of the parties concerned, and the trade in which the vessel is about to be employed. Such being the case, most mercantile firms have their own printed form of Charter-party, with blank spaces for the details relating to the trade for which the ship is hired. Nevertheless, it may be stated that the main features of this document have not varied for years past, for the most important questions involved in it refer to the risks and responsibilities of parties arising out of the usual perils of the sea, compensation for delays, alterations of the agreement, &c.; and it may be noted that the printed part is of as great weight as the written part.

The substance of a Charter-party is as follows:—The owners (or his agent, or the master) covenant to provide a ship, strong, staunch, and in every respect seaworthy; well and sufficiently found in sails, sailyards, anchors, cables, ropes, &c., and other instruments, tackle, apparel, furniture, pro-

visions, &c., needful and necessary for such a ship, and for the given voyage, together with an able master, and a sufficient complement of seamen ;—binding themselves also that the cargo shall be delivered *(the act of God, the King's enemies, and all and every other dangers and the accidents of the seas, rivers, and navigation, of whatever nature and kind soever, during the said voyage, always excepted)* in like good condition as when shipped, and with as much speed as may be, at the place of discharge agreed upon : it fixes the terms on which the cargo is to be carried, the number of lay days allowed for loading, and the amount for demurrage, and the merchant or charterer stipulates to comply with the payment promised for freight, and on demurrage, according to the terms of the contract. and both owner and charterer bind themselves in penalties for non-performance of the covenants, articles and agreements, in the Charter-party. It is signed by the contracting parties in the presence of a witness, who also puts his signature to it ; but when charterer and owner or (master) sign at different times, a witness is required to each signature. In terms of the stamp Act, to be a legal document, it must be stamped.

Letters altering a charter are liable to the same stamp duty as the Charter-party.

A charterer may load the ship with his own goods, or with those of other parties ; or he may underlet the vessel to another party provided no clause in the Charter-party prohibits him so doing.

As nearly all the rights and liabilities of both the merchant and shipowner respecting the carriage of cargo, depend on the stipulations contained in the Charter-party, and as both

parties are bound by the terms of the contract they thereby enter into, care should be taken that it contains no provisions which are unusual, or which may be prejudicial to the rights of the parties.

When a ship is chartered by the "month," calendar months are understood, and the master must accept any kind of cargo which is not injurious to the ship, and to any quantity within its carrying capacity, *unless* special provisions in the Charter-party restrict this right.

If the ship is chartered for a lump sum, the draught of water should be specified in the Charter-party to prevent over loading.

In chartering, do not allow the charterer to sign as agent unless you approve of his principle; nor agree that he shall not be liable for any delay in loading; nor that his responsibility shall cease when the cargo is on board; nor that the ship shall discharge in turn (unless according to the custom of the Port); nor that the master shall sign bills of lading at any rate of freight as presented and without qualification.

The ship must be properly dunnaged, according to the usages of the trade in which she is employed, or according to the nature of the cargo: and the goods must be stowed in the most approved method, so as to prevent damage.

For the purposes of loading and discharging the ship, state whether the *lay-days* are "running days" or "working days," according to the intention. Also be particular about the number of days and the amount to be paid *on demurrage*.

Lay days commence from the day when the ship is in her place of discharge (as per Charter-party), or as near thereto

as she can safely get. The place of discharge is determined by the custom of the Port and usage of the trade in which the vessel is engaged.

When no *lay-days* are specified, the length of time for loading and unloading must be determined by the nature of the cargo, or the number of days usually allowed at the Port. To be valid, the custom or usage of the Port must be a legal one.

If the owner or master is bound to provide ballast, he may put in heavy merchandise, provided that it occupies no more space than ballast would do, and is not injurious to the cargo.

If it is intended that the deck load is to be entirely at merchants' risk, let it be so stated in the Charter-party, otherwise the shipowner must bear his share of the loss, in general average, if it is jettisoned, and he cannot recover the amount from the under-writers.

As soon as the vessel has taken in full complement of cargo, and all things necessary are arranged, as clearing at the Custom house, payment of Port charges, &c., the voyage must be forthwith commenced, *weather* permitting.

The master must not take on board any contraband goods, or have in his possession any false or colourable papers whereby the ship and cargo are rendered liable to seizure; but he must obtain all papers and documents which are necessary to protect the ship and cargo in all the countries to which he is trading.

By the terms of the Charter-party, not to be held liable for injuries arising from "the act of God, and the King's

enemies, &c." the master or owner is not responsible for damage arising from the sea, winds, &c., unless such injury or damage be the result of negligence or imprudence.

When the Charter-party names a full and complete cargo, the master must take on board as much as he can, *with safety*, and without injury to the ship ; and the freighter is obliged to furnish the same, either of his own goods, or the goods of others.

The Charter-party should stipulate for a *full* cargo, if that is intended, otherwise the charterer will only be liable to pay on the quantity of goods which he ships, *unless* he has agreed to pay at the rate of so much per ton of the ship's capacity.

If any clause of the Charter-party is ambiguous, the interpretation should be liberal ; or if the Charter-party is silent in respect to any point, the usage of the trade in which the ship is employed must be adopted.

No master should consent to vary the terms of the Charter-party, or alter his voyage, without the greatest caution and then only with the charterer himself or his agent, having his written consent, which written consent ought to be given up to the master before making the alteration, otherwise the charterer will be discharged from the contract, and the owner liable to an action for breach of contract, If there be a telegraph, it would be better for the master to refer to his owner for instructions.

If the Charter-party is entered into by the master, then he must be sued by the charterer in case of any dispute, unless the master in signing, expressly states that he signs only as agent for the owner.

If, by the terms of a Charter-party, the ship has to proceed to a given Port, the merchant covenanting to furnish a cargo there, and on arrival the contracting party, or his agent is unwilling or unable to furnish a cargo, the master should on the expiration of the lay-days allowed by charter, protest against the merchant for non-fulfilment of the Charter-party, and he is then at liberty to return in ballast, and has right to the full freight. *The better plan*, however is to take the best homeward freight he can get, and claim the deficiency of freight from the merchant. It is not necessary to wait the demurrage days unless required so to do by the merchant or his agent. A prohibition by the government of the country to export the proposed articles of cargo, neither dissolves the contract, nor excuses the non-performance of it. Send the protest home to the owners.

If a consignee refuses, and persists in his refusal, to receive cargo within a reasonable time, the master had better, after consulting with and entering a protest before the Consul, sell the cargo for what it will fetch, and proceed on the Charter-party for the balance of freight, if any.

If while loading it becomes an admitted fact that the charterer is a bankrupt, the ship can repudiate the Charter, unless guaranteed by the bankrupt's assignees *personally*. An owner cannot be *compelled* to complete the Charter, and come for payment as one of the creditors. If, however, the ship has got sufficient goods on board to cover freight, demurrage, &c., and has a lien expressly given on the cargo to cover the same, the ship had better sail to her destination and so deliver the cargo as to insure payment of such charges.

Depth of water at discharging or loading port, according to draught of ship.—This is a very important thing for a master to ascertain before the terms of the Charter-party are settled and signed, as a vessel may have to wait for a spring tide to enter and depart; or the port may be a barred harbour, and she may have to discharge and load partly in the roads, and partly in the river or docks,—or she may, from her draught, not be able to enter the harbour at all and thus have to load and discharge in the roads; in any case, unless, according to circumstances, such provisions as—"so near as she may safely get," "lighten and load at merchant's expense," or other equivalent words are introduced into the Charter-party; the expenses entailed on the ship may be very considerable, and, in fact, a loss. Only in the case where it is the regular custom of the port to lighten the ship before she gets to her final berth, will the merchant be bound to do it.

Form of Notice to be given after the Lay-days and Demurrage days are expired, and a full Cargo has not been supplied :—

To Messrs.————

As the Lay-days for loading my ship———— expired on————last; and as according to the Charter-party, you have not yet supplied a full Cargo, I hereby require that you will forthwith inform me whether it is your intention to supply any more Cargo.

Also, take notice, that unless the remainder of the Cargo be supplied before————next, I shall, at the expiration of that time, proceed on my voyage with the quantity of Cargo you have supplied to the said ship, and you will be held liable

for Dead-freight and Damages for not supplying a full Cargo according to Charter.

Dated this———day of———19—

A. B.,

Master of the———

Form of Notice to be given after the Lay-days and Demurrage-days are expired, and no Cargo has been supplied :—

To Messrs.———

I hereby give you notice that the Lay-days for loading my ship———expired on———last, and as you have not yet supplied any Cargo, I require you forthwith to commence to load the said ship, according to the Charter-party. Should you neglect to do so, I shall, after———next hold myself at liberty to depart in ballast or re-charter the ship, according to circumstances, and you will be held responsible for all loss and damages which may be sustained by the owners of the said ship in consequence of your having neglected to load her.

Dated———day of———19—

A. B.,

Master of the———

N.B.—Keep copies of these Notices or enter them in the Log Book.

A Bill of Lading is a *formal receipt* signed by the master of the ship in his capacity of carrier, whereby he acknowledges that he has received, the goods specified on board his ship, and binds himself (under certain conditions) to deliver them, in the condition received, at the place, and to the person named in the bill, or to his assigns, on his, or their paying him the stipulated freight. If there is no

charter-party, then the Bills of Lading will be evidence of the contract, and of the shipment of the goods.

The usual form of a Bill of Lading is as follows :—

AUTHORISED FORM CONTINENTAL STEAM BILL OF LADING.

Shipped in apparent good order and condition by—— on board the Steamship or Vessel called the———— whereof is Master for this present voyage———— and now lying in this Port and bound for———— with liberty to call and/or receive and/or land Coals, Cargo and/or Passengers, at any Port or Ports, in any rotation, in or out of the customary route and with liberty to be towed in all situations, to sail with or without Pilots, and tow and assist Vessels at all times without being deemed a deviation.

being marked and numbered as in the margin, with liberty to tranship the said goods or specie on board any other Craft or Steamer, and to be delivered subject to the exceptions and conditions hereinafter mentioned in the like good order and condition, either into Lighter or on the Quay at Master's option, where the Ship's responsibility shall cease, at the port of————unto———— or to his or their Assigns,

freight payable, Ship lost or not lost, at

....Shillings and.....
Pence Sterling per ton Gross Weight
.....Pence Sterling per Cubic Foot
.....Shillings and.....Pence Sterling
} With percent. primage

and Average accustomed, as per York-Antwerp Rules, 1890, and Disbursements £..... .....as per margin.

1. The following are the exceptions and conditions above referred to:—The Act of God, The King's Enemies, Pirates, Robbers, Restraint of Princes, Rulers and People, Strikes or Combinations afloat or ashore, at home or abroad, Vermin, Jettison, Barratry and Collision, Fire on Board, in Hulk, or Craft, or on Shore, and all Accidents, Loss, and Damage, whatsoever, from Machinery, Boilers, Steam and Steam Navigation, or from Perils of the Seas, Canals and Rivers, or from any Act, Neglect, or Default, whatsoever, of the Pilot, Master, Officers, Engineers, Crew, Servants or Agents of the Owners, in the management or navigation of the Ship, or otherwise, and the Owner being in no ways liable for any consequences of the causes before mentioned.

2. The Ship, her Owners or Master, are not liable (as regards negligence or otherwise) for any loss, damage, or injury in respect of Animals, Coin, Jewellery, Pictures, Statuary, China, Glass, Plate, and Furniture, and similar articles of value unless previous arrangements in writing have been made.

3. Weight, Contents, Measure, Number, Quantity and value unknown, and not answerable for Leakage, Ullage, Spiles, Lighterage, Breakage, Rust, Breakage of Seals, Torn Wrappers, Corruption, inherent Deterioration, Stained, Repaired, or Insufficient Packages, Damage by Sweating, or contact with other Goods, Rain, or incorrectness or insufficiency in the marks or numbers. The Goods to be taken from the Ship by the Consignees as soon after arrival as the Vessel is ready to discharge, during day and night, Sundays and Holidays, at Ship's option, without interruption, or the same may be transhipped into Lighters and/or Landed on the Quays, and or Warehoused, and all at the expense and risk of the Owners of such Goods.

4. Machinery and all heavy weights are only accepted to be put on board and taken out at Merchant's risk and expense.

5. All Goods immediately they are discharged from the steamer shall be entirely at the risk of the consignees.

6. The Goods may, at Ship's option and Merchant's risk, be weighed and examined at the place of discharge, and if the weight and/

or description on the Bill of Lading be incorrectly stated, the cost of weighing and examination will be added to the freight and be payable before delivery of the Goods and double freight may be charged and payable.

7. Goods shipped as one parcel to be delivered in the same way.

8. In the event of Quarantine, Labour Strikes or Combinations. afloat or ashore, or Ice, or in case of riot, anticipated disturbances, or War (Great Britain being a belligerent or otherwise), blockade or interdict, of the port of discharge, or if the entering of or discharging, in the port shall be considered by the Master unsafe, the Goods may, at the Master's discretion, be discharged on arrival on to Quay or into Quarantine Depot, Hulk, Lighter, or other Vessels necessary for the Ship's dispatch, at the Consignee's risk and expense, or, should this be impracticable, or the vessel not admitted, the Master to have the option, and is hereby authorized, to land the Cargo at the Port which in the Master's judgment shall be most fit and convenient, at the risk and expense of the Consignees, where the ship's responsibility shall cease.

9. In the event of transhipment or forwarding on, it is understood that the clauses, conditions and restriction of the Ship or other conveyance, by which the Goods are forwarded to destination are included in this Contract, and all Stamps, Duties and Charges are to be paid by the Owner of the Goods.

10. Ship free in case of mortality. The Ship Owners will not be liable for any loss arising from suffocation or other causes, occuring to Horses, Dogs, Cattle, and other animals; or from the kicking, plunging or viciousness of the same in transit; nor for any damage from shipping or landing, or while in the possession of the Shipper, or his Agents, before or after the Voyage, from whatever cause they may remain in such possession. No Officer or Servant of the Ship Owner has authority to dispense with or vary these Conditions. And for the purpose of the Contract, the values of the undermentioned animals are to be taken as not

exceeding :—For Horses, £50; for neat Cattle, £15; and for Sheep, Pigs, and Dogs, £2 each.

In Witness whereof the Master or Agent of the said Vessel hath affirmed to Bills of Lading, exclusive of the Master's copy, all of this tenor and date, one of which Bills being accomplished the others to stand void.

Dated in London,.....19

.....

Master.*

*Disbursements £*_____

Never be induced to sign Bills of Lading before the goods are on board, or without the mate's receipts being given up or cancelled, or without first carefully reading them over and comparing one with the other; not only see that they are alike, and that the quantity of goods and rate of freight are correct, but that nothing is inserted contrary to the fact on the Charter-party if there be one.

Do not sign Bills of Lading for a less freight than what is stated in the Charter-party but say—"Freight, demurrage,

* In cases of through carriage and when land carriage, shipping, landing, lighterage, &c., or transhipping is effected by or at the cost of the Ship-Owner, it is so done at the risk of the Owner of the Goods, and neither the Ship-Owner, the Wharfingers, the Barge-Owners, nor Lightermen are responsible for the risks of lighterage, strikes or combinations afloat or ashore, damage by vermin, fire afloat or ashore, wharfage, or any insurable risk, and if through goods are landed at a different port, the extra cost attending discharge, carriage, &c., and otherwise, shall be a charge upon the goods, and be borne by the Consignees.

Merchants are particularly requested to see that their Policies of Insurance include all the above and other expected risks on Bill of Lading.

and *all other conditions* as per Charter," for the consignee of the cargo is ordinarily only liable to carry out the requirements named in the Bill of Lading, as he does not necessarily know the terms of the Charter-party.

Insert the *correct* number of days consumed in loading, on the margin of the Bill of Lading.

Interest and insurance on money advanced, and address commission paid at port of loading, ought to be endorsed on the Bills of Lading. This is a receipt which the receivers of the cargo cannot dispute.

According to circumstances and the state in which goods are shipped, qualify your risk by adding—"quantity and quality unknown," or "weight and quantity unknown," or "weight and contents unknown," or "number and contents unknown." If the master suspects the contents of the cases, &c., damaged, he can demand to see them, but he is not justified in opening a case unless the shipper or his agent is present. The master should, however, give the shipper notice in writing, and if he fails to replace such damaged goods with sound, say—"shipped in a damaged condition," or "shipped in an improper condition."

With liquid goods you may add—"not accountable for leakage," or with brittle goods—"not accountable for breakage"; but here you are only protected so far as the leakage or breakage arises from accidental causes, not when such damage arises from negligence or want of care.

Enter deck load at shipper's or charterer's risk, even if provided for in Charter, or otherwise.

If the shipper refuse to allow the qualifications stated above, or the insertion of any words the master considers ought to be inserted on the bill of lading, sign under protest, thus :—

"*Signed under Protest.*"
A. B., Master.

Bills of Lading, when there is no Charter-party, should say—"Consignee paying freight, demurrage, and all other charges"; also, "goods to be taken from alongside at Consignee's expense and risk."

In England it is customary in the case of ships loading general cargoes for abroad, to sign Bills of Lading for freight paid in advance, but not to receive it for a month or six weeks after the sailing of the vessel: in this case, say—"nevertheless the owners to have a lien on the goods for freight until paid."

Three Bills of Lading should be stamped; one for the shipper, another for the consignee, and the third for the master's use and guidance in delivering cargo; but a *copy* requires no stamp. A master is not bound to sign a Bill of Lading unless it is properly stamped, as it cannot be stamped afterwards. In England the penalty for signing an unstamped bill of lading is £50.

A master of a ship, on signing Bills of Lading, ought clearly to understand he is only required to give a receipt for the cargo; not to enter into a second agreement; hence the necessity of referring to the Charter-party in the Bill of Lading for "freight and conditions"—the Bill of Lading being the last document signed.

A master has no right to insert any new conditions in the Bills of Lading, and the charterer is justified in such a case in detaining the ship until the bills are duly signed. Also if the charterer, after the expiration of the lay-days, detains the ship by not presenting proper Bills of Lading for the master's signature, the charterer will be liable to pay demurrage for such detention.

Refuse to sign Bills of Lading binding you to go to any other place or places of discharge than the place or places covenanted for in the Charter party. If you cannot get proper Bills of Lading after waiting a reasonable time, protest, and sail without them, or sign them under protest as to the contents objected to.

A master must sign the necessary ship and cargo papers, in whatever language they are, but he is not bound to sign a document he does not understand; therefore, before signing foreign Bills of Lading, &c., it is his duty to have them explained by his consul, or a Notary Public, as some of them omit the usual exceptions, "the act of God; the King's enemies, &c. (*see* above), and have objectionable clauses in them. Where they cannot be translated, add—"freight and all other conditions as per Charter-party; and anything contrary thereto to be void.

After signing one set of Bills of Lading, do not sign another set unless those previously signed are given back to you to be destroyed; you might otherwise find yourself liable to deliver goods to the holders of both sets.

Every indorsee of a Bill of Lading, to whom property in the goods passes by the indorsement, is now liable to the shipowner, and the shipowner is liable to him in case

of any breach of contract. An indorsee, however, who indorses it again to another party, does not remain liable after indorsing it away.

Deliver the cargo to no one unless he produce one of the Bills of Lading which you have previously signed, properly indorsed.

A Bill of Lading may be negotiated by simple indorsement and delivery, which will carry a right to the goods.

LAY-DAYS.—This is the term applied to the number of days specified in the Charter-party for loading and discharging a vessel.

As a general rule, *i.e.*, in the absence of a custom of the Port, or a stipulation to the contrary, "lay-days" mean "running days," and include Sundays and fixed holidays; one exception being where the ship has reported too late for the Merchant to begin discharging in fair time on Saturday, in which case the Merchant would be entitled to begin to count his "lay-days" from the following Monday, or first *working* day, which the late reporting of the ship on Saturday gives him the advantage of; the ship's days would then run on as *running* days—the succeeding Sundays and holidays counting as "days" against the Merchant. Also, in most Continental ports, according to usage, holidays count as Sundays, in which case the Merchant would not recognize a notice given on such a day, and the ship's time would only count from the day after the holiday. In London, however, by the custom of the port, "days" are held to mean "working days," unless otherwise specified.

"Lay-days, Sundays excepted," mean "working days;" Sundays not counting as days.

"Running lay-days" mean every day to count, viz.: working days, Sundays, and holidays.

"Lay-days," subject to the exception stated above, are to be construed to count as "running lay-days."

In calculating a ship's "days, part of a day is reckoned as a whole day; thus, though discharging did not commence until 2 h. or 3 h. P.M., that day would count against the Merchant.

Lay-days for discharging cargo commence the day after the vessel is entered at the Custom-House, and after her arrival at the usual place of discharge in the port; but she must be *ready* to discharge her cargo before the days begin to count; and if some particular place in the port is specified in the Charter, they do not commence until that place is reached. If a vessel can get over a bar at spring-tide, and afterwards discharge afloat, she must wait for the springs, and the lay-days will not commence until she is in her place of discharge.

If a vessel is according to her Charter, always to lay afloat, and has arrived within the limits of her port of discharge or as near thereto as she can *safely* get, and has to be lightened to reach her final discharging berth, the days, day, or part of a day consumed in towing up to, or otherwise reaching that final place, would count in the lay days.

Also, if the clauses of the Charter-party stipulate, "calling at C——for orders, which are to be given in ——hours, or lay-days commence," and ——"days at Port of delivery for unloading," then the lay-days commence at C——after the

expiration of the given hours allowed for receiving orders, and they may be deducted from the days allowed for unloading.

"Regular turn" is explained and governed by the usage of the Port; and a vessel's lay-days in this case commence when her turn comes.

"Usual dispatch" is held to mean the usual dispatch of persons who have a cargo in readiness; and "reasonable time," if there is no usage of the Port to decide the question, means a reasonable time under *ordinary* circumstances.

If a vessel is duly loaded within the time named as lay-days, and she is ready for sea, the Charterer has no power to detain her.

Form of Notice that Ship is ready to load.—

To Messrs.———

Take Notice that my vessel the———is now lying at ———, and is now ready to receive her cargo. The Lay-days, according to Charter-party, commenced———, and will expire on———; after which time the vessel will be on Demurrage.

Dated this——day of———19—.

A. B., Master of the———.

Form of Notice that Ship is ready to Unload.

To Messrs.———

Take Notice that my vessel the ———arrived here ———, and is now ready to unload. The Lay-days for discharging the cargo will expire on———, and after that date you will be liable, per Charter-party to pay Demurrage

at the rate of £———per day. If the discharge of the cargo is commenced before you pay the Freight, I will reserve my right to detain a sufficient portion of the cargo until said Freight is paid.

Dated this——day of———19—.

A. B., Master of the———

N.B.—Do not forget to keep copies of these notices, and a memorandum of the date on which they were delivered.

DEMURRAGE. If a vessel is detained, either in loading or unloading, for a longer term than the number of days stated in the Charter-party, or on the Bills of Lading, the Shipowner is entitled to *Demurrage*, the rate of which *per day*, is also stipulated for in the Charter-party.

Demurrage can only be claimed for detention at the port of loading, and at the port of discharge. It should also be claimed day by day as it arises, and on Saturday for Sunday, for *all* days count on demurrage, even if the Charter-party specifies that the Lay-days are to be working days only. Further, if no notice has been served on the Merchant for Demurrage, the claim resolves itself into one of undue detention, which must be proved, and is outside the Charter-party.

A ship-owner has no lien on the cargo for Demurrage, unless that is a stipulation in the Charter-party or Bills of Lading.

If a Charter-party provides for a certain number of days *on demurrage*, at a given rate per day, and the vessel is detained longer than the time specified, then, for the additional term, the ship-owner is not restricted to the amount of de-

murrage named in the Charter-party ; but the only way to secure a claim on an increased scale, is to give ample notice that if the vessel is detained beyond the days named *on demurrage*, an increased rate per day will be charged as compensation for the detention.

If lay-days are not mentioned in the Charter-party or Bill of Lading, the vessel must be loaded or unloaded with reasonable dispatch ; and if demurrage is supposed to accrue, it must be regulated by the custom of the Port, by the decision of arbitrators, or by a jury, as to what, under the circumstances, would be a fair and reasonable time for loading or discharging.

The owner is the proper party to sue in a demurrage case,

Form of Notice that Ship is on Demurrage :—(Loading.)

To Messrs.——

Take notice that the lay-days for loading my vessel, the ————, expired on————and since that time she has been, and is still on demurrage, for the payment of which you and all concerned will be held liable.

Dated this————day of————19—

A.B., Master of the————

Form of Notice that Ship is on Demurrage :—(Discharging.)

To Messrs.————

Take notice that the lay-days for discharging the cargo in my vessel, the————, have expired, and that she is now on demurrage, for the payment of which you and all concerned will be held liable.

Also, take notice, that if you neglect forthwith to discharge the said cargo, you and all concerned will be held

liable for all expenses of storing the same, should it become necessary to do so.

Dated this————day of————19—

A. B., Master of the————

N.B.—Do not forget to keep copies of these notices, and a memorandum of the date of delivery.

CARGO AND ITS STOWAGE.—Owners and Masters are considered in law in the same situation as common carriers, and it cannot be too clearly understood that the payment of freight very much depends on the care bestowed on the cargo. All due precautions must therefore be taken to receive and stow cargoes in good order, so that the goods may be delivered in the like good order and condition (the act of God, dangers of the seas, &c., excepted).

Owners have often had large sums to pay for damage to cargo, arising from the following causes, which with ordinary care might have been prevented :—runs not being clear; dunnage not being good and sufficient; ship not being properly matted out; pump well, mast cases, bulkheads, shifting boards, and chain locker not being substantial and secure; neglected air ports, by which cargo reaches the pumps and chokes them; leaky ports; covering of hatchways and coating of masts being insufficient or imperfect; inattention to pumps; improper stowage; cutting timber or deals, and breaking open packages (for stowage) beyond what is provided for by the Charter, by the usages of the trade, or without the written consent of the Charterer or shipper; deck load being carried over a perishable cargo; rats, mice, and other vermin.

The law holds the shipowner liable for the safe custody of the goods when properly and legally received on board in good order, and for the "delivery" to parties producing the Bills of Lading.

Goods are not unfrequently sent alongside in a damaged state, and letters of indemnity given to the master by the shippers for signing in good order and condition; this is nothing more or less than conniving at fraud. Fine goods are often damaged in the ship's hold by lumpers, if permitted to use cotton-hooks in handling bales. All goods must be received on board according to the custom of the port where the cargo is to be taken in, and the same custom will regulate the responsibility of the master and owner.

Before taking in Cargo, see that the limbers are clear; the hold well swept; examine the mast cases, pump well, and chain trunks; and have the dunnage properly laid.

The parts that require most dunnage are the bilges, pump well, masts, in the wake of the chain plates, scuppers, hooks and transoms; in the 'tween decks lay the dunnage athwartships.

During the voyage attend the pumps carefully, and enter in each day's log,—"pumps carefully attended."

Stow cases with the mark and number uppermost.

Stow bales on their flats, mark and number uppermost; except wing bales, which stow on their edges.

Stow oil, resin, pitch, tar, &c., in the fore peak.

Stow casks bung up and bilge free; the ground tier on beds, and put quoins on top of the beds at each side; the next tier in the cantlines of the ground tier, and put quoins

under the quarters at each side : chock them off in the wings with dunnage wood between the quarters of the casks and the wings. If you have but a hundred or so casks, stow them in the fore hold.

Stow acid, vitriol, &c., on deck, ready to throw overboard, if necessary.

For an entire cargo of iron, rig a platform about a foot higher than the keelson ; then lay it grating fashion from the after part of the fore hatch to the fore part of the after hatch keeping the bars an inch or two apart ; carry it over into the wings right up both sides, taking care to have bars along the sides to keep the chafe off the skin ; bring it up from the ends in a slant towards the main hatch ; secure it by tomming it off from the beams, with planks under the toms.

A part cargo of iron stow fore-and-aft from the after part of the fore hatch to the fore part of the after hatch, until level with the keelson ; then grating-fashion, and bring it up square at the ends.

All dead weight as iron, copper, lead, and other metals, used to stiffen the ship, should be stowed in the bottom, from the after part of the fore-hatch to the fore part of the after-hatch.

Stow a heavy piece of machinery in the centre of the main hold.

To stow a cargo of copper ore.—A good substantial platform should be built above the keelson, and a trunkway formed by building strong bulkheads in the wings, well shored and cleated from the sides ; by this means you keep the dead weight in the body of the ship, rising it, and render-

ing the ship easier in a sea-way. N.B.—If materials for building a trunk-way are not available, good strong casks (the head-staves perpendicular) will make a good substitute ; the ground tier forming the platform, and winging up with casks at the sides,

To stow guano.—The hold and limbers having been prepared, dunnage as high as the keelson, and three or four inches in the sides ; the masts, pump well, &c. being well cased round and matted ; then sew bags together and line the ship throughout, nailing the bags to the sides where necessary, being careful to see all listing pieces and air-holes are filled in. N.B.—Ships are found with sufficient bags and twine by the shipper.

Or, build a platform as high as the keelson ; then partially fill bags with guano, so that when stowed, the bottoms of the half-filled bags shall lay over the mouths of each other : line the lower hold in this manner, then fill in with guano in bulk. By this plan you save time and twine, but the former method is preferable. N.B.—The ship to be balked at the ends by filled bags.

To stow a cargo of tea.—Dunnage the ship with good *dry* stone ballast even with the upper part of the keelson, or higher, according to the vessel's stability and the heights of chests you can stow under the lower deck beams ; level the ballast and round it down towards the wings to give it the same curve as the deck and beams , also throw up sufficient ballast fore and aft in both wings to chock off the three lower tiers. The ballast should then be covered with *thin dry* boards, and the ground tier stowed, keeping the lower corners of the wing chests from 14 to 16 inches from the bilges ; then fill in the

wings with ballast, levelled and covered with dry boards: now stow the second or riding tier, keeping the lower corners of the wing chests 10 or 12 inches from the sides, and chock off by filling in the wings with small ballast; stow the third tier, keeping the lower corners of the wing chests 4 inches from the sides, filling and chocking off with ballast. When the third tier is stowed it should be a perfect level, fore and aft, with a gradual droop towards the wings, according to the curve of the beams. Above this tier dunnage the sides from 3 to 4 inches, up to the lower beams—in the 'tween decks 1 to 2 inches of dry dunnage laid athwartships—sides the same. The pump well, chain locker, masts, &c., should be *well* dunnaged. N.B.—With a tea cargo great care should be used in selecting dry hard stone or shingle; the same remark applies to the dunnage.

Wood Cargoes. The principal provisions of the Merchant Shipping Act relating to carrying wood cargoes on deck are as follows:—

Between the last day of October and the sixteenth day of April, vessels must not arrive in the United Kingdom with *(a)* Any square, round, wany, or other timber, or any pitch pine, mahogany, oak, teak, or other heavy wood goods, whatever, or *(b)* Any more than five spare spars or store spars, whether or not made, dressed and finally prepared for use, or *(c)* Any deals, battens, or other light wood goods* of any descriptions to a height exceeding 3 feet above the deck.

* Light wood goods of poplar *other* than deals and battens may be carried, provided that no piece exceeds 8 cubic feet, and light fir goods also with a limit of 7 cubic feet.

The master, and also the owner if he is privy to the offence, shall be liable to a penalty of not exceeding £5 for every 100 cubic feet of goods carried contrary to the Act.

The following instructions for stowage of various cargoes are according to Lloyds' rules :—

HEMP, FLAX, WOOL and COTTON, should be dunnaged 9 inches on the floors, and to the *upper part* of the *bilge*, the wing bales of the second tier kept 6 inches off the side at the lower corner, and $2\frac{1}{2}$ inches at the sides. Sand or damp gravel ballast to be covered with boards. *Sharpbottom ships one-third less dunnage in floors and bilges.* Avoid Horn Shavings as dunnage from Calcutta.

All CORN, WHEAT, RICE, PEAS, BEANS, &c., when in bulk, to be stowed on a good high platform, or dunnage wood, of not less than 10 inches, and in the bilges 14 inches dunnage ; the pumps and masts cased, to have strong bulkheads, good shifting boards, with feeders and ventilators, and to have no admixture of other goods. Flatfloored, wall-sided ships should be fitted with bilge pumps. On no consideration must the stanchions under the beams be removed.

OIL, WINE, SPIRITS, BEER, MOLASSES, TAR, &c., to be stowed bung up ; to have good *cross beds* at the quarters, *(and not to trust to hanging beds)*, to be well chocked with wood, and allowed to stow three heights of pipes or butts, four heights of puncheons, and six heights of hogsheads or half-puncheons. All moist goods and liquids, such as SALTED HIDES, BALES OF BACON, BUTTER, LARD, GREASE, CASTOR OIL, &c., should not be stowed too near "dry goods," whose

nature is to absorb moisture. Shipowners have often to pay heavy damages for leakage in casks of Molasses, arising from stowing too many heights without an intervening platform or 'twixt decks. From Bengal, goods also are frequently damaged by Castor Oil

TEA, and FLOUR in barrels ; FLAX, CLOVER, and LINSEED, or RICE in tierces ; COFFEE and COCOA in bags, should always have 9 inches at least, of good dunnage in the bottom, and 14 inches to the upper part of the bilges with $2\frac{1}{2}$ inches at the sides ; allowed to stow six heights of tierces and eight heights of barrels. All ships above 600 tons should hava 'twixt decks or platforms laid for these cargoes, to ease the pressure—caulked 'twixt decks should have scuppers in the sides, and $2\frac{1}{2}$ inches of dunnage laid athwart ship, and not fore-and-aft ways, when in bags or sacks ; and when in boxes or casks not less than 1 inch. RICE from Calcutta is not unfrequently damaged by indigo, for want of care in stowing.

Entire cargoes of SUGAR, SALTPETRE, and GUANO, in bags must have the dunnage carefully attended to, as laid down for other goods. TIMBER ships are better without 'twixt decks if loading all timber or deals. Brown sugar to be kept separate from white sugar, and both kept from direct contract with Saltpetre.

POT and PEARL ASHES, TOBACCO, BARK, INDIGO, MADDERS, GUM, &c., whether in casks, cases, or bales, to be dunnaged in the bottom, and to the upper part of the bilges, at *least* 9 inches, and $2\frac{1}{2}$ inches at the sides.

MISCELLANEOUS GOODS such as boxes of CHEESE, kegs and tubs of LARD, or other small or slight-made packages.

not intended for broken stowage, should be stowed by themselves, and dunnaged as other goods.

Barrels of PROVISIONS, and TALLOW CASKS, allowed to stow six heights. All METALS should be stowed under, and separated from goods liable to be damaged by contact.

All MANUFACTURED GOODS, also DRY HIDES, Bales of SILK, or other valuable articles, should have $2\frac{1}{2}$ inches of dunnage against the side, to preserve a water-course. Bundles of SHEET IRON, RODS, pigs of COPPER or IRON, or any rough hard substance, should not be allowed to come in contact with bales or bags, or any soft packages liable to be chafed. When mats can be procured they should be used at the sides for Silk, Tea, &c.

TAR, TURPENTINE, RESIN, &c., to have flat beds of wood under the quarters, of an inch thick, and allowed to stow six heights.

Very frequent and serious loss falls on merchants on the upper part of cargoes, particularly in vessels that bring wheat, corn, tobacco, oil cake, &c., arising from vapour damage imbibed by wheat, flour and other goods stowed in the same vessel with turpentine, or other strong scented articles: the shippers are to blame for such negligence, for not making due inquiry before shipping.

Ships laden with full cargoes of coal, bound round Cape Horn, or Cape of Good Hope, to be provided with approved ventilators as a preventive against ignition.

No vessel bound on any over-sea voyage, should on any account be loaded beyond that point of immersion which will present a clear side out of water, when upright, of three

inches to every foot depth of hold, measured amidships, from the height of the deck at the side to the water. In stowing 42 cubic feet measurement make a ton.

STOWAGE OF GRAIN CARGOES FROM CANADA AND THE UNITED STATES.—No ship exceeding 400 tons register can be entirely loaded with grain in bulk; and all exceeding 400 tons register may take two thirds of the cargo grain in bulk, and one-third in bags, or rolling freight instead thereof. In the latter case, the grain in bulk should be stowed six inches but not more above the beams, to allow for settling.

When ships take wheat, corn, &c., in bulk, it must be stowed in sections or "bins" (not to contain more than 12,000 bushels each), to be lined with thoroughly seasoned boards, grain tight, not less 10 inches from the flat of the floor, and from 14 to 16 inches in the bilges, graduated to the sides, which must be clapboard lined to the deck. Care must be taken to preserve a water-course under the lining. Goods shifting boards, secured to the stanchions, extending at least six feet downwards and fitted tight to the deck. The stanchions not to be removed, but firmly secured No loose grain to be stowed in the extreme ends and no admixture of other goods. Pumps and masts cased and covered with mats or canvas, made thoroughly grain-tight, with sufficient space in the well to admit the passage of a man to the heels of the pumps, and access had to the same by means of a manhole from the deck, or by a clear passage from the 'tween decks aft. Mats to be used for covering knees, keelson, and stanchions, if required, but not for lining or covering the sides.

Grain, when stowed in bags, must be dunnaged not less than 10 inches on the floor, 14 to 16 inches in the bilges, 3 inches on sides up to the deck; between decks the dunnage must be laid thwart ships, at least 2 inches from the deck. Shifting plank extending at least 4 feet from deck beams downwards, secured to stanchions. The dunnage in the hold must be entirely covered with boards and sails, or mats, grain-tight.

All bulk or loose grain must be taken in bins prepared for that purpose.

For dunnaging deals are preferable to anything else. They should be laid fore and aft about 3 inches apart, the second tier over the spaces of the first tier, the third tier over the spaces of the second, and so on. Staves or other materials generally used for dunnage to be placed so as to give free course for the water to reach the pumps. The dunnage should be raised from 10 to 12 inches from the floor, and in the bilges from 14 to 16 inches, according to the build of the ship, and the discretion of the Inspector. Flat-floored wall-sided ships should be fitted with bilge pumps

The studs for the bulkheads should be made of three inch deals, placed about two feet apart, and firmly secured at the top and bottom, and properly braced and cleated on the lining and to the beams (or deck), to resist the pressure of the grain.

The studs for the bulkheads forward, and after bulkheads for ships not exceeding 10 feet depth of hold, must be 4 by 6 inches in size, and of one entire piece; of a greater depth than 16 feet, they must be 4 by 8 inches. They must be

set 20 inches apart from centre to centre, firmly secured at the top and bottom, and properly braced and cleated on the ceiling and deck to resist the pressure of the grain.

The sides above the turn of the bilge must be lined on 1 inch battens after the manner of clapboarding.

Shifting planks 2 inches thick must extend to the deck on each side of the stanchions, fitted tight under and between the beams and carlines, and extending not less than 6 feet downwards; care must be taken that the stanchion are well secured at both ends. In no case can single boards be substituted for plank, and the shifting-boards must be shored from sides, midway between the stanchions.

Materials for bins must be perfectly seasoned: unseasoned lumber must not be used where it will come in contact with the grain. Water-tanks, whether of wood or iron, must be cased with wood to prevent damage from sweat or leakage. And all ships with grain in bulk ought to have feeders and ventilators.

It must be seen that the grain is well trimmed up between the beams, and the space between the beams completely filled.

When ships are chartered, the draught of water should be limited, and provision made for loading under inspection.

The load-draught must be regulated by the depth of the hold, allowing three inches to every foot depth of hold, measured from lowest line of sheer of deck amidships to the water, when upright. Ships having an additional deck put on after construction, the depth of hold to be measured from original deck.

The foregoing is a rough rule ; but a vessel must not be loaded beyond her load line, or "Plimsoll mark" in salt water. This mark ought to be amidships, it consists of a horizontal line, 18 inches long by 1 inch broad through the centre of a disc 12 inches in diameter. The centre of the disc (and line) indicates the maximum depth to which the vessel ought to be loaded for the voyage. The position of each deck above the load line is indicated by a line 12 inches long by 1 inch broad, the upper edge of which should be level with the upper edge of the deck plank next to the waterway. A "Plimsoll mark," unless assigned by Lloyds' is not a guarantee that the vessel is not overladen if loaded to such mark.

Ships loading grain complying strictly with the above rules, lined and loaded under the supervision of the surveyor appointed by Lloyds' agents, will be entitled to a certificate to that effect.

The loading of Grain Cargoes is regulated by Act of Parliament. The requirements of the Act are as follows :—

In a grain laden ship (that is, a vessel carrying more than one-third of her register tonnage* of grain), loading from North America or from the Mediterranean or Black Sea :—

(a) There shall not be carried between the decks, or if the ship has more than two decks, between the main and upper decks, any grain in bulk except such as may be necessary for feeding the cargo in the hold, and is carried in properly constructed feeders.

* This third is computed at the rate of 100 cubic feet to the ton or by weight, at two tons weight to the ton.

(*b*) Where grain (except such as may be carried in properly constructed feeders) is carried in bulk in any hold or compartment, and proper provision for filling up the same by feeders is not made, not less than one-fourth of the grain carried in the hold or compartment (as the case may be) shall be in bags, supported on suitable platforms laid upon the grain in bulk. Provided that this regulation with respect to bags shall not apply

(i.) To oats or cotton seed; nor

(ii.) To a *sailing* vessel of less than 400 tons register and not engaged in the Atlantic trade.

(iii.) Nor to a Black Sea or Mediterranean trader, if the ship is divided into compartments of not more than 1,500 quarters (375 tons), each with a properly constructed feeder of 2% of its capacity measured from the underside of the deck upwards), and with shifting boards from deck to keelson with beam fillings, and not more than one-fourth of her grain cargo in any one compartment.

(iv.) To a ship in which the grain cargo does not exceed one half of the whole cargo of the ship, and the rest consists of cotton, wool, flour, or other suitable cargo, so stowed as to prevent the grain in any compartment, bin, or division from shifting.

(*c*) Where grain is carried in the hold or between decks, whether in bags or bulk, the hold or space between decks shall be divided by a longitudinal bulkhead, or shifting boards, extending right up and down, with beam fillings and grain tight if the grain is in bulk.

(*d*) In loading, the grain shall be properly stowed, trimmed, and secured.

These precautions of the Act do not apply to ships loaded to Board of Trade regulations.

A declaration must be made by the master abroad to the British Consul, or the principal officer of Customs, that the ship is properly stowed; and on arrival a similar notice must be given to the Customs. For failing to give this notice, or for making a false statement, the penalty is £100, and both master and owner, and also the agent abroad, are liable to penalties under the Act if the cargo is not properly stowed.

Crew Spaces, *Caution.*—Never stow any part of the cargo, nor put any stores in the space allotted to the crew, as each man can claim one shilling per day for the whole time that the crew space is so occupied. Vide Merchant Shipping Act.

Freight is the sum which the merchant pays for the safe conveyance of cargo, or for the use of the ship; it is payable according to the terms of the Charter-party.

Do not make the freight payable two months, or any time *after* the delivery of cargo, but either "during the delivery or "on delivery." When bills are to be given, have them good and approved bills, and not charterer's acceptance. When foreign money is to be paid, make it "at current rate of exchange."

When an advance of freight is to be paid, make it payable on signing Bills of Lading, and not on the sailing of ship.

If it has been necessary to abandon the vessel, freight will be earned by conveying the goods to their destination by the best means which circumstances will admit of.

Freight cannot be claimed on damaged cargo sold at an intermediate port ; hence, it is always better to put it into the best condition possible, and bring it on.

If the freight is calculated by time, it begins to run from the period of the ship's breaking ground, and commencing her voyage.

The owner has a lien on the cargo for freight, but none on goods conveyed for dead freight.

A ship having been fully chartered to the charterers, the master has no right to fill his cabin for his own or his owner's benefit so as to receive "extra" freight as against charterers ; the latter may claim compensation on showing loss. The master's is a permissive custom rather than a right.

If goods are increased in bulk (as in the case of grain), freight must be calculated on the quantity put on board ; if there has been a decrease (as in the case of molasses, &c.,) it must be calculated on the quantity delivered.

Where a lump sum has to be paid for freight, and a part of the cargo only is delivered in consequence of some accident, a proportionate sum will be payable.

Though the cargo be so much damaged when the ship arrives at the port of destination as not to be worth the freight, the merchant cannot avoid payment of the freight by abandoning the cargo to the shipowner, from whatever cause the damage may have arisen.

"Right and true delivery," means delivery of the right quantity, although the quality may be damaged.

Where the amount of freight named in the Bills of Lading differs from that named in the Charter-party, the master can only claim from the consignee the amount named in the Bills of Lading, and the lien on the cargo is only for that amount; the balance must be claimed from charterer.

The master can detain for the freight any part of the cargo consigned to the same person; also, in case the cargo is damaged, or where there is short delivery, he can hold it till the whole freight due on the quantity delivered is paid.

PROTESTS AND SURVEYS.—It is always safe and judicious, even when no damage to cargo is apprehended, to note a protest, "against wind and weather," within 24 hours after the ships arrival at her port; if need be, this protest can then be extended according to the exigencies of the case. A protest is made before a Notary Public; if there is no such person, then before a British Consul, a magistrate, or the collector of customs. Keep a copy of the noting, and have it signed as a "true copy."

A ship having received damage, or having touched the ground during the voyage to her port of loading, ought to be surveyed, and a certificate of her sea-worthiness, in duplicate, obtained before taking on board cargo.

If it is found necessary to put into an intermediate port for repairs, the master must have a certificate of survey on the damage received, and the ship's sea-worthiness before

leaving. If the cargo be a perishable one, and there is reason to think it is damaged, it will be necessary to have a survey on it, and obtain a certificate that it is, or has been, put into proper condition for the passage to the port of destination.

If in consequence of bad weather there is reason to suppose the cargo has been damaged, before opening hatches at the port of discharge, get two shipmasters, (as surveyors) to inspect them, and obtain from them a certificate of survey (in duplicate), stating that the hatches have been well parcelled and battened down; the same surveyors can also inspect the damaged packages of cargo, and certify as to whether they were properly dunnaged and stowed, giving a certificate respecting them.

Under any circumstances let the surveyors, when a certificate of survey is necessary, be two shipmasters, or a shipmaster and a merchant uninterested in the cargo.

A certificate of survey, specifying that the hatches were properly battened down, and the cargo sufficiently dunnaged and generally well stowed, but that the goods were damaged by sea water, prevents a claim being made on the ship for the amount of damage.

When you proceed to extend your protest, take with you to the Notary the certificates of survey and the log book, and leave them with him till the claims are settled; be careful that whatever statements you make are correct.

The owner should have a copy of the certificate of survey, and also of the protest, transmitted to him by post; the other the master keeps *for his own use.*

CALLING FOR ORDERS.—When you call at one port for orders to discharge or load at another, ask for your orders in *writing*, and take care of them, as they will be useful in case of dispute.

AN INVOICE for shipping purposes is an account of goods sold or consigned, containing a description of the goods, with their marks and numbers ; their prime cost ; and charges which include freight, insurance, entry bond duty, dock charges, lighterage, &c.

A COCKET is a Custom-house warrant, given on the entry of goods for exportation, in evidence of their having paid duty, or being duty free.

MANIFEST.—This is a document made from the Bills of Lading, dated and signed by the master at the place of lading. It sets forth the ship's name ; Port of registry ; registered tonnage ; master's name ; a specific account and description of *all* goods on board, with their marks and numbers thereon ; the names of the shippers and consignees ; the place or places where the goods have been received on board, and the place or places for which they are respectively destined ; and in fact, *full particulars* relating to the ship, the cargo, the crew, and the passengers, if any.

It must be handed over to the Custom-house authorities on the arrival of the ship at the port of destination ; and must also be ready to be produced at any intermediate port the ship puts into. In many places goods on board and not in the manifest are not only liable to confiscation, but the master is subjected to a heavy penalty for the omission ; and no such ambiguous term as "merchandise" is admitted

Entry Inwards and Clearance Outwards.—The master must immediately on reaching his port of destination see that his vessel is *entered inwards* at the Custom-house, and take with him the manifest and all the necessary papers for that purpose. So, on his departure he must likewise have his *clearance outwards*.

Bill of Health.—Every ship on leaving port should be furnished by the sanitary authority with a bill of health, which should be countersigned by a Consul of the country to which she is bound, otherwise she is liable to unnecessary delay and detention in quarantine; a similar bill should be obtained at intermediate ports belonging to different countries.

Bottomry and Respondentia.—Bottomry is the mortgaging of a ship, when, in a foreign port, the master cannot obtain money on his own, or his owner's credit; it is a bond whereby the ship is pledged as security for the repayment of money borrowed to repair the ship, and so complete the voyage; the money advanced, together with the premium or interest, becomes repayable on the ship terminating the voyage successfully,—the vessel as well as the borrower being then liable for the money lent.

If the ship is lost, the lender loses the money; and since he has to sustain the hazard of the voyage, he is allowed a greater interest or premium than the usual rate acknowledged by law.

If on a voyage, two or more bottomry bonds be entered into, the last is payable first, since they take precedence in the reverse order of the bonds being taken up.

Money borrowed on bottomry must be obtained by advertisement, and the lowest offer (of interest) accepted.

The seamens's wages must be paid before the bottomry bond.

If money is necessary and it cannot be obtained on bottomry, the cargo may be pledged : this is *respondentia* and is subject to the same laws as bottomry.

If money cannot be obtained on bottomry or on respondentia, the master may sell a part of the cargo.

Lloyd's Form of Bottomry Bond, and Respondentia are as follows :—

LLOYD'S FORM OF BOTTOMRY BOND.

KNOWN ALL MEN BY THESE PRESENTS that I Master of the Ship of the Port of of the burthen of tons or thereabouts am held and firmly bound unto of in the sum of sterling British money, to be repaid to the said his agent, attoney, executors, administrators, or assigns, for which payment I bind myself, my heirs, executors, and administrators, and also bind and hypothecate the said ship and the freight to become due in respect of the voyage aftermentioned and the cargo laden or to be laden on the said voyage firmly by these Presents sealed with my seal. Dated this day of 19 *WHEREAS the said ship lately arrived at in distress, having sustained damages in the course of a voyage from to laden with

*This recital should be varied according to the facts.

and being in want of repairs, supplies, and provisions to enable her to continue her said voyage : AND WHEREAS the said being without funds or credit at and urgently requiring the sum of to pay the said repairs, supplies, and provisions, and to discharge the lawful and necessary disbursements of the ship at and to release her from her liabilities, and to enable her to continue her voyage, and having first duly communicated or attempted to communicate with the owners of the said ship and of the said cargo with a view to obtain funds from them, was compelled to apply for a loan upon bottomry of his ship, her cargo and freight : AND WHEREAS the said who is hereinafter called the said lender, proposed and agreed to advance upon such security the said sum of at a maritime premium of per cent. for the said voyage, and the said being unable to procure such advance in any quarter on more advantageous terms, accepted the said proposal [with the intervention and approval of the proper authorities at], and agreed so far as he lawfully could or might that the said security should have priority over all other claims on the said ship, freight, and goods, whether by himself or any other person : AND WHEREAS the said lender has duly advanced the said sum in pursuance of the said agreement : NOW THE CONDITION of the above obligation is such that if the said do with the said ship and cargo duly prosecute the said voyage without unnecessary delay or deviation, and do within days after the arrival of the said ship or cargo at

and before commencing to discharge or deliver her cargo there, pay or cause to be paid to the said lender or to his order or assigns the said sum of together with maritime premium thereon at the rate aforesaid, making in all the sum of such payment to be made at the exchange of for every British pound sterling, or if the said ship with the said cargo shall duly prosecute the said voyage without unnecessary delay or deviation, and shall be by perils of the sea lost in the course of such voyage, then this obligation shall be null and void, and the said shall be released from all liability in respect of the said sum of PROVIDED ALWAYS, and it is hereby agreed and declared, that if the said ship shall by perils of the sea as aforesaid be lost or so much damaged as to be unable to complete her said voyage, then if any part of the said ship or cargo or of the said freight shall be saved or earned, the above security, so far as regards the property saved or freight earned, shall remain in force, and the said lender or his assigns shall be at liberty forthwith to enforce the same against such property and freight: PROVIDED ALSO, and the said loan is made on the express condition, that the said lender doth not accept or take upon himself any risk or liability on the said voyage except such as is hereby expressly mentioned, and shall not be liable to contribute to or make good any general or particular average loss or expenditure or other charges of a like nature which may happen to or be sustained by or incurred in respect of the said ship or her cargo of freight upon the said voyage in consequence of perils of the sea or otherwise,

Signed, sealed, and delivered by the said
in the presence of

LLOYD'S FORM OF RESPONDENTIA BOND.

KNOW ALL MEN BY THESE PRESENTS

that I (the Master of the original Ship or other person having charge of the Cargo and intending to forward it) of am held and firmly bound unto (the Lender) of in the sum of sterling British money, to be repaid to the said his agent, attorney, executors, administrators, or assigns for which payment I bind myself, my heirs, executors, and administrators, and and also bind and hypothecate the cargo of laden or to be laden on board the ship (Forwarding Ship) for the voyage aftermentioned firmly by these presents. Sealed with my seal Dated this day of 19

*WHEREAS the ship (Original Ship) lately arrived at in distress in the course of a voyage from to with the above-named cargo, and the said vessel being found incapable of carrying on the said cargo the said (the Master of the original ship or other person having charge of the cargo) determined in the interest of all parties concerned to forward the said cargo to its destination in the ship (Forwarding Ship)

AND WHEREAS in order that the said cargo might be so forwarded it became necessary to provide funds to meet the expenses of discharging, warehousing, and reshipping the said cargo and other necessary disbursements on account of the said cargo†

AND WHEREAS the said being without funds

*This recital should be varied according to the facts.

†And/ or to discharge certain liabilities in respect of which the said Cargo was subject to liens and to arrest and sale.

or credit at and urgently requiring the sum of for the said purposes, and having first duly communicated with or attempted to communicate with the owners of the said cargo with a view to obtain funds from them, was compelled to apply for a loan upon respondentia; AND WHEREAS the said who is hereinafter called the said lender proposed and agreed to advance upon such security the said sum of at a maritime premium of per cent. for the said voyage, and the said being unable to procure such advance on more advantageous terms, accepted the said proposal [with the intervention and approval of the proper authorities at], and agreed to far as he lawfully could or might that the said security should have priority over all other claims upon the said cargo, whether by himself or any other person: AND WHEREAS the said lender has duly advanced the said sum in pursuance of the said agreement: NOW THE CONDITION of the above obligation is such that if the said do use his best endeavours to forward or bring the said cargo to its destination without unnecessary delay or deviation, and do within days after the arrival of the said cargo at and before the discharge or delivery of the said cargo shall be commenced, well and truly pay or cause to be paid to the said lender or to his order or assigns the said sum of together with the maritime premium thereon at the rate aforesaid, making in all the sum of such payment to be made at the exchange of for every British pound sterling, or if the said cargo shall be duly dispatched and forwarded on the said voyage without unnecessary delay or deviation, and the said cargo shall by perils of the sea be lost in the

course of such voyage. Then the above-written obligation shall be null and void and the said shall be released from all liability in respect of the said sum of

PROVIDED ALWAYS and it is hereby agreed and declared that if the said cargo shall in the course of the said voyage by perils of the sea as aforesaid be lost or so much damaged as that it cannot be carried to its said destination, then if any part thereof shall be saved the above security, so far as regards the property saved, shall remain in force, and the said lender or his assigns shall be at liberty forthwith to enforce the same against such property: PROVIDED ALSO, and the said loan is made upon the express condition, that the said lender does not accept or take upon himself any risk or liability on the said voyage except such as is hereby expressly mentioned, and shall not be liable to contribute to or make good any general or particular average loss or expenditure or other charges of a like nature which may happen to or be sustained by or incurred in respect of the said cargo or the said ship upon the said voyage in consequence of perils of the sea or otherwise.

Signed, sealed and delivered by the said
in the presence of

AVERAGE, in the law of shipping, is generally applied to the loss occasioned by any sacrifice made to insure the safety of a ship and cargo; it is usually settled by an "average adjuster."

General average applies when the ship's gear or cargo or any portion of the same is sacrificed for the general benefit of the ship and cargo, or any necessary expenditure for the same

purpose. Particular average is applied to any accidental damage or loss to the vessel or cargo.

Lloyd's Form of Average Bond is as follows :—

LLOYD'S AVERAGE BOND.

AN AGREEMENT made this day of 190 BETWEEN Master of the Ship or Vessel called the and the several Persons whose names or Firms are set or subscribed hereto, being respectively consignees of Cargo on Board the said Ship of the other part

WHEREAS the said Ship lately arrived in the Port of on a voyage from and it is alleged that during such voyage she met with bad weather and sustained damage and loss and that sacrifices were made and expenditure incurred which may form a Charge on the Cargo, or some part thereof, or be the subject of a general average contribution, but the same cannot be immediately ascertained, and in the meantime it is desirable that the cargo shall be delivered ; NOW THEREFORE THESE PRESENTS WITNESS and the said Master on his own behalf, and on behalf of his owners, in consideration of the agreement of the parties hereto of the second part hereinafter contained, hereby agrees with the respective parties hereto of the second part, that he will deliver to them respectively their respective consignments, on payment of the freight payable on delivery, if any, and the said parties hereto of the second part in consideration of the said Agreement of the said Master for themselves severally and respectively, and not the one for the others of them,

hereby agree with the said Master that they will pay to the said Master or the owners of the said Ship the proper and respective proportion of any general average, or particular or other charges which may be chargeable upon their respective consignments, or to which the Shippers or Owners of such consignments may be liable in respect thereof to contribute to such damage, loss, sacrifice, or expenditure, and the said parties hereto of the second part, further promise and agree forthwith to furnish to the Captain or Owner of the said Ship a correct account and particulars of the value of the goods delivered to them respectively, in order that any such general average and other charges may be ascertained and adjusted in the usual manner.

*AND WHEREAS at the request of the Owner of the said Ship the parties hereto of the second part have respectively deposited or agreed to deposit in the Bank of in the joint names of nominated on behalf of the Shipowners and nominated on behalf of such Depositors the sum of £ per cent. on the amount of the estimated value of their respective interests. NOW IT IS HEREBY further agreed, that the sum so deposited by the said parties respectively shall be held as security for and upon trust for the payment to the parties entitled thereto, of the general average and particular charges payable by the said parties hereto of the second part respectively, as aforesaid, and subject thereto upon trust for the said Depositors respectively.

IN WITNESS

*This addition to be made to the agreement in those cases which justify the Shipowners in asking for a deposit.

PORT CHARGES are generally taken to include pilotage towage, harbour and hospital dues, &c., and whatever charges of a similar description are customary at any given port.

SHIPPING AND DISCHARGING CREW,—SHIP'S ARTICLES OF AGREEMENT,—VICTUALLING SCALE.—A few days before the ship is ready for sea, attend at the Shipping Office and state your requirements as regards hands, &c.; you will there be furnished with all the necessary preliminary papers, and the seamen will, in due course, be procured for you, and desired to attend on the day you propose to *sign Articles*. These Articles of Agreement state the character of the voyage, and fix the *status* of each of the crew, the rates of wages, the scale of victualling, &c. On the given day, and at the given time, the Articles of Agreement, the Victualling Scale, and the Regulations for maintaining discipline (sanctioned by the Board of Trade) are read to the crew, the Deputy Superintendent seeing that they understand what has been read, and, if necessary, explaining it to them. The master first signs his name in full to the Agreement on Duplicate, and fixes the day and hour the crew are to be on board which is duly entered on the Agreement: the crew then sign in rotation: the Deputy-Superintendent then attests the execution of the Agreement, and previous to dismissing the crew informs them when they are to be on board. When all the arrangements are completed, and all the necessary papers signed and attested, the master will receive from the Deputy Superintendent the Ship's papers, together with the Certificates, Indentures and Discharges of the crew, and all requisite forms; also the Clearance Certificate to be produced to the Collector and Comptroller of Customs.

When about to sail, nail a copy of the Victualling Scale in the forecastle, where it can be seen by the crew: also muster the crew to ascertain if all are on board; if any are missing, ship others in their place; when the pilot leaves give him a copy of the Articles to take to the owners, with a list of the deserters and their substitutes.

Similarly, the crew must be discharged at a Shipping Office on the completion of the voyage, and "an account of wages must (under a penalty not exceeding £5) be filled up and delivered to each member of the crew, at least 24 hours before he is paid off, and no deduction will be allowed unless duly inserted." On the given day for paying off "Discharges" being ready for delivery, the crew must muster at the Office; the master will first sign the "Release," and as the men are paid off, they will sign it also in rotation each receiving from the deputy Superintendent his discharge You will also have to give an account of the wages and effects of all deceased seamen.

If the crew or any portion of them are to be discharged abroad, and there is no Shipping Office, it must be done before the Consul.

Every seaman has a lien on the ship for his wages.

There is no *authorized* VICTUALLING SCALE; whatever the crew agrees to, they must abide by, but the articles as proposed must be served out in the proper quantities, else they are entitled to compensation; the following scale was promulgated by the Committee of the General Shipowner's Society.

Days of the week.	Bread	Salt. Beef.	Salt. Pork	Flour	Rice	Peas.	Tea.	Sugar.	Mustard.	Water.	Per Act Parliament. Vinegar	Lemon or Lime Juice	Sugar for Lime Juice
		lb.	lb.	lb.		pt	oz.	lb.		qt	pt.	oz.	oz.
Sunday ..	As much as they can eat without waste.	1½	—	½	1 lb. per week.	¼	⅔	⅔	To be considered as an extra, and issued at the discretion of the Master.	3	—	½	½
Monday ..		1¼	1¼	—		—	⅔	—		3	—	½	½
Tuesday ..		—	—	½		¼	⅔	—		3	—	½	½
Wednesday		1¼	1¼	—		—	⅔	—		3	—	½	½
Thursday ..		1½	—	½		¼	⅔	—		3	—	½	½
Friday ..		—	1½	—		—	⅔	—		3	—	½	½
Saturday ..		1¼	—	½		¼	⅔	—		3	—	½	½
Sunday ..		—	1¼	—		¼	⅔	⅔		3	½	½	½
Monday ..		1½	—	½		—	⅔	—		3	—	½	½
Tuesday ..		—	1¼	—		¼	⅔	—		3	—	½	½
Wednesday		1¼	—	½		—	⅔	—		3	—	½	½
Thursday ..		—	1¼	—		¼	⅔	—		3	—	½	½
Friday ..		1¼	—	½		—	⅔	—		3	—	½	½
Saturday ..		—	1¼	—		¼	⅔	—		3	—	½	½
Totals for 14 days		8¾	8¾	3½		1¾	3½	1½		42	1	7	7

When bread is allowanced out, it must be 1 lb. per man per day,

SUBSTITUTES.—1 oz. of coffee or cocoa or chocolate for ¼ oz. of Tea.

Molasses for Sugar ; the quantity to be one-half more.

1 lb. potatoes or yams to be considered equal to ½ lb. flour or rice, or ¼ pint peas.

When *fresh meat* is issued, the proportion to be 2lb. per man per day, in lieu of salt meat, flour, rice and peas.

The allowance of small stores being considered as an equivalent for spirits, spirits are only to be issued under particular circumstances at the discretion of the master.

Caution respecting *Lime Juice*:—By the Merchant Shipping Act, 30 & 31 Vict. c. 124, s. 4,—Lime or lemon juice, sugar, and vinegar, are to be served out to the crew,

whenever they shall have been consuming salt provisions for *ten days*. The lime or lemon juice and sugar daily, after the rate of half an ounce of each per day, and the vinegar weekly, at the rate of half a pint per week to each person, so long as the consumption of salt provisions be continued.

The following is the Official Form (blank) of Victualling Scale given in the "Agreement and Account of Crew."

Scale of Provisions to be allowed and served out to the Crew during the Voyage in addition to the daily issue of Lime and Lemon Juice and Sugar, or other antiscorbutics in any case required by 30th and 31st Vict. C 124. S 4,

	Bread lb.	Beef lb.	Pork lb.	Tinned Meats lb.	Soup and Bouilli Pints	Preserved Potatoes	Compressed or Preserved Vegetables lb.	Flour lb.	Peas Pint.	Rice	Tea oz.	Coffee oz.	Sugar oz.	Molasses oz.	Water qts.
Sunday ..															
Monday ..															
Tuesday															
Wednesday															
Thursday															
Friday ..															
Saturday															

Note.—In any case an equal quantity of Fresh Meat or Fresh Vegetables may at the option of the Master, be served out in lieu of the Salted or Tinned Meats o Preserved or Compressed Vegetables named in the above Scale.

SUBSTITUTES.

SHIP'S LOG-BOOK.—The ship's log-book kept and written up daily by the chief mate, and signed by the master, should receive more attention than is ordinarily bestowed upon it, for it is impossible to say at what time it may be

required as evidence in a court of law; besides which, the remarks in it are the foundation of the master's protest, and consequently they should be strictly correct. The remarks should describe most particularly the wind and weather, and the effects on the ship as regards any accidents that may arise therefrom,—the amount of damage sustained and the cause to which it may justly be attributed, as far as can be ascertained at the time; the latitude and longitude; the hour of occurrence; the attention given to the pumps, and to the lead-line, &c. All interlineations and erasures should be avoided; and if any correction is necessary while writing it, make it by drawing the pen through the error.

It is also requisite that the log-book should be properly written up by the time the ship arrives at the Port of destination, ready to be produced when asked for, as in case of damage to ship or cargo, serious difficulties may otherwise be experienced in the settlement of average.

These requirements are especially necessary, for in many foreign Ports, the Notary Public, on receiving the log-book, may examine any two of the crew privately and separately on the statements therein, before receiving the master's protest: and again, in some Ports it is required by the authorities that the ship's officers, on arrival, should sign the page where the writing ends, for the purpose of preventing any subsequent additions.

A master is allowed to use any form of log-book he prefers.

The Official Log-book of the voyage for certain special entries, must also, by the Merchant Shipping Act, be kept by every ship master, who is further required, within 48

hours after the ship's arrival at her final Port of destination in the United Kingdom, or upon the discharge of the crew, whichever happens first to deliver it to the Shipping master, before whom the crew is discharged. Full and ample instructions will be found in the first pages of that book, for filling up all the various entries; it is unnecessary, therefore, to give them here in detail, beyond stating that they relate to the name of the ship and official number; name of the master; the voyage; a list of the crew, stating the conduct, character, and qualification of each man; a list of the passengers; an entry of all offences, convictions, punishment, fines, illness or injuries, medical treatment, deaths, births, and marriages, wages of seaman entering the Royal Navy, wages and sale of the effects of any seaman who may die during the voyage, collisions, and the circumstances under which the same have occurred.

N B.—Neglect to comply with the requirements specified entails a penalty, and ignorance is not held to be a justifiable plea for such negligence.

It may, however, be incidentally noticed that special attention must be given to make particular and correct *entries of wages and effects of deceased seamen;* and when a man commits an offence, no deduction from his wages on that account can be made unless there is an entry of the date, ship's position, and charge made against him; the entry having been made, then read the charge to the man in the presence of the mate or a witness, stating in writing that you have so read it; sign it, and let the mate sign as witness; call upon the man for his defence, and if he make any, write it under the offence; then sign again as before.

MERCHANT SHIPS' PAPERS.

Papers required to be carried by the Ocean-going Merchant Vessels of Great Britain:—The papers required by British law to be carried by British Merchant Vessels to establish their Nationality are :—

A. CERTIFICATE OF REGISTRY *or* PROVISIONAL CERTIFICATE granted by a Consul resident in a foreign country for a vessel bought there.

The other papers required to be carried by a British vessel are :—

B. AGREEMENT AND ACCOUNT OF CREW.
Official Log Book.
Ship's Log Book.
Manifest of Cargo.
Bills of Lading.
Charter-party, if the vessel is chartered.

AGREEMENT AND ACCOUNT OF CREW (For Foreign-going ship);—is a document of 16 pages. The front page is headed AGREEMENT AND ACCOUNT OF CREW (Foreign-going ship). Contains general terms of the agreement entered into between the master and the crew, the rations to be allowed, besides other particulars, and is signed by the master, and under certain circumstances detailed by a Superintendent, Officer of Customs, or Consular Officer.

Pages 2-9—Contains in a tabular form, consisting of 20 numbered columns, the signatures of the crew, the particulars of their agreement, discharge, or release, attested by the signature or initials of a Superintendent, Consul, or Officer of Customs; space is provided for 80 names. *Page 10*—

Contains an ACCOUNT OF APPRENTICES ON BOARD (if any) in a tabular form. Under this table is a space sub-divided, headed, Certificates, or indorsements made by Consuls, or by officers in British Possessions abroad. *Page 11-15*—Each page is sub-divided and contains a similar heading to that last mentioned. *Page 16*--Contains REGULATIONS FOR MAINTAINING DISCIPLINE AND INSTRUCTIONS TO MASTERS. The latter are comprised in 22 numbered paragraphs.

NOTE.—In Foreign Ports if the master is superseded he must turn over all the Ship's Papers to his successor, a list of them is to be entered in the Official Log Book and signed by himself, his successor, and a witness. The crew have also to sign fresh Articles of Agreement.

WIRE ROPE, HAWSERS, &c.—For a general description of the manufacture of wire rope, &c., &c., Vide Art. 218.

CHAIN CABLES.—The method of manufacture of chain cables for the Merchant Service is practically the same as that described, vide Art. 217. The iron is not quite of equal quality.

The tests differ from the Admiralty requirements to the extent of 10 per cent., the cables having to stand 40 per cent. more than the Proof strain instead of 50 per cent., as in the case of the Royal Navy cables.

SALVAGE WORK.—The Form of Salvage Agreement published by Lloyd's is as follows :—

STANDARD FORM OF

SALVAGE AGREEMENT

(Approved and Published by the Committee of Lloyd's.)

NO CURE—NO PAY.

On board the

Dated 190

It is hereby Agreed between Captain of the (afterwards called "the Master") and (afterwards called "the Contractor") as follows :—

1. The Contractor agrees to use his best endeavours to salve the and her cargo and take her into or other place to be hereafter agreed with the Master, providing at his own risk all proper steam and other assistance and labour. The services shall be rendered and accepted as salvage services upon the principle of "no cure—no pay" and the Contractor's remuneration in the event of success shall be £ , that being the sum demanded by him, unless this sum shall afterwards be objected to as hereinafter mentioned in which case the remuneration for the services rendered shall be fixed by Arbitration in London in the manner hereinafter prescribed : and any other difference arising out of this agreement or the operations thereunder shall be referred to Arbitration in the same way.

2. The Contractor may make reasonable use of the vessel's gear anchors chains and other appurtenances during and for the purpose of the operations free of costs but shall not necessarily damage abandon or sacrifice the same or any other of the property.

3. Notwithstanding anything hereinbefore contained should the operations be only partially successful without any negligence or want of ordinary skill and care on the part of the Contractor or of any person by him employed in the operations, and any portion of the Vessel's Cargo or Stores be salved by the Contractor, he shall be entitled to reasonable remuneration not exceeding a sum equal to per cent. of the estimated value of the property salved at or if the property salved shall be sold there then not exceeding the like percentage of the net proceeds of such sale after deducting all expenses and customs duties or other imposts paid or incurred thereon but he shall not be entitled to any further remuneration reimbursement or compensation whatsoever and such reasonable remuneration shall be fixed in case of difference by Arbitration in manner hereinafter prescribed.

4. The Contractor engages not to arrest or detain the Vessel or Cargo or property salved except in the event of any attempt being made to remove the same from without his consent before the said sum of £ or the said maximum remuneration mentioned in Clause 3 (as the case may be) has been deposited in Cash with the Committee of Lloyd's to abide the result of the Arbitration hereinbefore mentioned, or such security or bail therefore as the Committee may in there absolute discretion consider sufficient has been given to them to abide the like result. Subject to this Agreement the Contractor shall have a lien on the property saved for his remuneration.

5. The Committee of Lloyd's after the expiry of 42 days from the date of the Deposit having been made or security

or bail having been given as provided for in Clause 4 shall realize or enforce the same and pay over the amount thereof to the Contractor unless they shall meanwhile have received written notice of objection and a claim for Arbitration from any of the parties entitled and authorized to make such objection and claim or unless they shall themselves think fit to object and demand Arbitration. The receipt of the Contractors shall be a good discharge to the Committee for any monies so paid and they shall incur no responsibility to any of the parties concerned by making such payment and no objection or claim for Arbitration shall be entertained or acted upon unless received by the Committee within the 42 days above mentioned.

6. In case of Arbitration the Committee of Lloyd's shall forthwith upon the publication of the Award pay to the Contractor out of the Cash deposit, or by realizing or enforcing the security or bail the amount awarded to him, and shall pay the balance (if any) of the deposit to the Depositors whose receipts shall be a good discharge for the same. If the award increases the remuneration the parties mentioned in Clause 12 shall pay the difference to the Contractor.

7. The Committee of Lloyd's shall not be in any way responsible for the sufficiency of any security or bail accepted by them, nor for the default or insolvency of any person giving security or bail.

8. In case of objection being made and Arbitration demanded, the remuneration for the services shall be fixed by the Committee of Lloyd's as Arbitrators or at their option by an Arbitrator to be appointed by them, unless they shall within 30 days from the date of this Agreement receive from the Contractor a written or telegraphic notice appointing an

Arbitrator on his own behalf, in which case such notice shall be communicated by them to the Managing Owner of the vessel and he shall within 15 days from the receipt thereof give a written notice to the Committee of Lloyd's appointing another Arbitrator on behalf of all the parties interested in the property salved; and if the Managing Owner shall fail to appoint an Arbitrator as aforesaid the Committee of Lloyd's shall appoint an Arbitrator on behalf of all the parties interested in the property salved or they may if they think fit direct that the Contractors nominee shall act as sole Arbitrator; and thereupon the Arbitration shall be held in London by the Arbitrators or Arbitrator so appointed. If the Arbitrators cannot agree they shall forthwith notify the Committee of Lloyd's who shall thereupon either themselves act as Umpires or shall appoint some other person as Umpire. Any award of the Arbitrators or Arbitrator or Umpire shall be final and binding on all the parties concerned and they or he shall have power to obtain call for receive and act upon any such oral or documentary evidence or information (whether the same be strictly admissible as evidence or not) as they or he may think fit, and to conduct the arbitration in such manner in all respects as they or he may think fit, and to maintain reduce or increase the sum demanded by the Contractor. The Arbitrators or Arbitrator and the Umpire (including the Committee of Lloyds if they act in either capacity) may charge such fees as they may think reasonable, and the Committee of Lloyd's may in any event charge a reasonable fee for their services in connection with the Arbitration, and all such fees shall be treated as part of the costs of the Arbitration and Award and shall be paid by such of the parties as the Award may direct.

Save as aforesaid the statutory provisions as to Arbitration for the time being in force in England shall apply.

9. The Committee of Lloyd's may in their discretion out of the Cash deposit or out of the security or bail (which they may realize or enforce for that purpose) pay to the Contractor on account before the publication of the Award such sum as they may think reasonable on account of any out-of-pocket expenses incurred by him in connection with the service.

10. The Master is not authorized to make or give and the Contractor shall not demand or take any payment Draft or Order for or on account of the remuneration.

11. Any dispute between any of the parties interested in the property salved as to the proportions in which they are to contribute to the Cash deposit or the sum awarded or provide the security or bail or as to any other matter concerning them shall be referred to and determined by the Committee of Lloyd's whose decision should be final and is to be complied with forthwith.

12. The Master enters into this Agreement as Agent for the Vessel and Cargo and the respective Owners thereof and binds each (but not the one for the other or himself personally) to the due performance thereof.

13. Any of the following parties may object to the sum named in Clause 1 as excessive or insufficient having regard to the services which proved to be necessary in performing the Agreement or to the value of the property salved at the completion of the operations and may claim Arbitration viz.:—(1) The owners of the ship (2) Such other persons together interested as Owners and/or Underwriters of any part not being less than one-fourth of the property salved as

the Committee of Lloyd's in their absolute discretion may by reasons of the substantial character of their interest or otherwise authorize to object (3) The Contractor (4) The Committee of Lloyd's—Any such objection and the award upon the arbitration following thereon shall be binding not only upon the objectors but upon all concerned provided always that the Arbitrators or Arbitrator or Umpire may in case of objection by some only of the parties interested order the costs to be paid by the objectors only, provided also that if the Committee of Lloyds in their public capacity be objectors they shall not themselves act as Arbitrators or Umpires.

14. If the parties to any such Arbitration or either of them desire to be heard or to adduce evidence at the Arbitration they shall give notice to that effect to the Secretary of Lloyd's and shall respectively nominate a person in London to represent them for all purposes of the Arbitration and failing such notice and nomination being given within 14 days or such longer period as the said Committee of Lloyd's may allow after the notice of objection the Arbitrators or Arbitrator or Umpire may proceed as if the parties failing to give the same had renounced their right to be heard or adduce evidence.

15. Any award, notice, authority, order, or other document signed by the Deputy Chairman or Secretary of Lloyd's on behalf of the Committee shall be deemed to have been duly signed by and shall have the same force and effect in all respects as if it had been signed by every member of the Committee.

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